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# An Economic Impact Of Covid-19 In India

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***Abstract : The current Indian economy has different challenges; it is impact on both demand and supply which has led to down India's economic growth. Meanwhile the Corona virus pandemic has set foot in India as well as global. It is affecting to the country's primary, secondary economic sectors and service sectors. This research article identifies theeffects of India's Gross Domestic Product contributors and economic compensations due to the Covid-19 pandemic using the long-term distribution of a Markov Chain Analysis. In addition, the paper seeks to find the effects of the five sectors of the Indian economy due to the Covid-19. The results from this paper suggest to the government of India to alternate economic planning in the affected sectors of the economy. Moreover, the information may be helpful in constructing an economic recovery plan for the Indian economy post Covid-19.***

***Keywords: Gross Domestic Product, Economic recession, Covid-19, steady state, Markov Chain.***

## 1. INTRODUCTION

The corona virus came to light on December 31, 2019, subsequently the disease spread to more Provinces in china, and to the rest of the world. Since the inception of Covid-19 in china, the economy has been coming from on the threatening globally. While the economic impact has not only been felt in china and the European countries, it is also in India.
The government had started taking precaution measures since the virus would have a huge economic impact once started in India. As a result, we can see now India has secure economic status compare with other virus affected countries, however the impact is known to be long lasting.
This research article helps to find the impact of Indian economy using a long-term distribution of a Markov chain model. It also helps to find the remedial action for impacted Indian economy.

## 2. INDIAN ECONOMIC MODELING

### 2.1. An overview of Indian Economic Status

Poor→ Lower Middle→ Middle Class→ Upper Middle→ High

- **Poor Class:** An annual household income of a family less than 90 thousand INR in India is considered as poor class. ( $c_1$)
- **Lower Middle Class:** Anannual income of a family earning between 50,000 and 4.5 Lakhs a year.($c_2$)
- **Middle Class:** An annual income of a family of four earning between 10 and 15 Lakhs.
  ( $c_3$)
- **Upper Middle Class:** An annual income of a family of four earning between 25 and 30 Lakhs. ( $c_4$)
- **High Class:** No need to say about their lifestyle. They decide country economy. ( $c_5$)

## 3. THE LONG-TERM DISTRIBUTION OF A MARKOV CHAIN

### 3.1. The stationary probability distribution:

Let $\pi_j$, jϵ S is a stationary probability distribution for a Markov Chain with transition matrix P if the following conditions hold for all j in S:

$\pi_j$ = $\sum_{i\in S} \pi_i p_{ij}$ ---------- (1)

$\pi_j \geq 0$ ---------(2)

$\sum_{i\in S} \pi_j$ =1 ---------- (3)

Equation (1) can be stated in the compact form as$\pi = \pi P$ where $\pi$ is viewed as a row vector. The interpretation of (1) is that, if we take $\pi$ as our initial probability distribution, that is to say

P [$X_0$ = i] =$\pi_i$, then the distribution at time 1is again given by$\pi$:

P [$X_1$ = j] = $\sum_{i\in S} P[\ X_1 =$j \ $X_0 =$ i] P [$X_0 =$ i] = $\sum_{i\in S} \pi_i p_{ij} = \pi_j$ ---------- (4)

The same is true at all times n≥1, so that $\pi$ is an invariant probability distribution.

### 3.2. The long-term behavior of Markov chains:

The importance of the stationary distribution comes from its connection with the long-term behavior of aMarkov chain. Under suitable conditions, a Markov chain will settle down to its necessary distribution after a sufficiently long period of time.

## 4. DATA ANALYSIS

### 4.1. An overview of Top Most Indian Economic Sectors

- **Agriculture Sector**: This is known as the primary sector of the Indian economy. This sector includes forestry and fishing also, currently it contributes only 15.57% of IndiaGDP.($E_1$)
- **Banking & Insurance Sector:** This is financial sector dominated by both banking & insurance companies. It is looking attractive for long-term investment.($E_2$)
- **Manufacturing Sector:** This sector has emerged as one of the high growth sectors in India. It is expected to become the fifth largest manufacturing country in the word by the end of year 2020. ($E_3$)
- **Infrastructure development Sector:** The infrastructure sector is an important driver of the Indian economy. This is main reason for driving India's overall economic development. ($E_4$)

- **Tourism Sector:** In India Tourism industry is the largest service industry with a contribution of 9.2% of the country's GDP. It is expected to be the second largest employer in the world by 2020. ($E_5$)

### 4.2. India Economic sectors According to the GDP Contributions

Table 1: Economic sector vs. % Contribution to GDP in India

| **Economic Sector** | **% Contribution to GDP** |
|---|---|
| Agriculture Sector = $E_1$ | 15.57% |
| Banking & Insurance Sector = $E_2$ | 15.1% |
| Manufacturing Sector = $E_3$ | 16.0% |
| Infrastructure development Sector = $E_4$ | 9.0% |
| Tourism Sector = $E_5$ | 9.2% |

Source of data: Statista 2020

### 4.3. The Economic sector Vs % Contribution to GDP in India can be summarized in weight index:

Table 2: Weight Index per GDP Contribution

| **Economic Sector** | **Weight Index** |
|---|---|
| Agriculture Sector = $E_1$ | $\frac{E_1}{\sum_1^5 Ei} = \frac{15.57}{64.87} = 0.240$ |
| Banking & Insurance Sector = $E_2$ | $\frac{E_2}{\sum_1^5 Ei} = \frac{15.1}{64.87} = 0.234$ |
| Manufacturing Sector = $E_3$ | $\frac{E_3}{\sum_1^5 Ei} = \frac{16.0}{64.87} = 0.247$ |
| Infrastructure development Sector = $E_4$ | $\frac{E_4}{\sum_1^5 Ei} = \frac{9.0}{64.87} = 0.139$ |
| Tourism Sector = $E_5$ | $\frac{E_5}{\sum_1^5 Ei} = \frac{9.2}{64.87} = 0.142$ |

The Weight Index will be written as a

$\Pi = (\pi_1, \pi_2, \pi_3, \pi_4, \pi_5)$

$\Pi = (0.240, 0.234, 0.247, 0.139, 0.142)$ -------- (5)

### 4.4. Proportion of the Economic Status in India

Table 3: Economic Status in India

| **Economic Status** | **%of the Population** |
|---|---|
| Poor Class | 20.0% |
| Lower Middle Class | 45.0% |
| Middle Class | 17.0% |
| Upper Middle Class | 12.0% |
| High Class (Upper Class + Super Rich Class) | 6.0% |

Source of data: Pew Research Centre

## 5. CALCULATION

We can fill the probability transition matrix below as follows from Table 3.

$$P_{x,j}^{ij} = \begin{bmatrix} 0.2 & 0.45 & 0.17 & 0.12 & 0.06 \\ 0.2 & 0.45 & 0.17 & 0.12 & 0.06 \\ 0.2 & 0.45 & 0.17 & 0.12 & 0.06 \\ 0.2 & 0.45 & 0.17 & 0.12 & 0.06 \\ 0.2 & 0.45 & 0.17 & 0.12 & 0.06 \end{bmatrix} \text{---------- (6)}$$

By Matrix solving equation (i.e.,) $\Pi * P = \Pi$

$$(\pi_1,\pi_2,\pi_3, \pi_4, \pi_5) \begin{bmatrix} 0.2 & 0.45 & 0.17 & 0.12 & 0.06 \\ 0.2 & 0.45 & 0.17 & 0.12 & 0.06 \\ 0.2 & 0.45 & 0.17 & 0.12 & 0.06 \\ 0.2 & 0.45 & 0.17 & 0.12 & 0.06 \\ 0.2 & 0.45 & 0.17 & 0.12 & 0.06 \end{bmatrix} = (\pi_1,\pi_2,\pi_3, \pi_4, \pi_5)$$

$\pi_1 = 0.2\pi_1 + 0.2\pi_2 + 0.2\pi_3 + 0.2\pi_4 + 0.2\pi_5$
$\pi_2 = 0.45\pi_1 + 0.45\pi_2 + 0.45\pi_3 + 0.45\pi_4 + 0.45\pi_5$
$\pi_3 = 0.17\pi_1 + 0.17\pi_2 + 0.17\pi_3 + 0.17\pi_4 + 0.17\pi_5$
$\pi_4 = 0.12\pi_1 + 0.12\pi_2 + 0.12\pi_3 + 0.12\pi_4 + 0.12\pi_5$
$\pi_5 = 0.06\pi_1 + 0.06\pi_2 + 0.06\pi_3 + 0.06\pi_4 + 0.06\pi_5$
$\pi_1 + \pi_2 + \pi_3 + \pi_4 + \pi_5 = 1$

We can rearrange the above five equations as follows to solve easily;

$-0.8\pi_1 + 0.2\pi_2 + 0.2\pi_3 + 0.2\pi_4 + 0.2\pi_5 = 0$
$0.45\pi_1 - 0.55\pi_2 + 0.45\pi_3 + 0.45\pi_4 + 0.45\pi_5 = 0$
$0.17\pi_1 + 0.17\pi_2 - 0.83\pi_3 + 0.17\pi_4 + 0.17\pi_5 = 0$
$0.12\pi_1 + 0.12\pi_2 + 0.12\pi_3 - 0.88\pi_4 + 0.12\pi_5 = 0$
$0.06\pi_1 + 0.06\pi_2 + 0.06\pi_3 + 0.06\pi_4 - 0.94\pi_5 = 0$
$\pi_1 + \pi_2 + \pi_3 + \pi_4 + \pi_5 = 1$

Again we can arrange the above first five equations as follows to solve easily;

$\pi_1 = 0.48781\pi_2$
$\pi_3 = 0.39465\pi_2$
$\pi_4 = 0.29269\pi_2$
$\pi_5 = 0.14634\pi_2$

Then substituting the above all equations in $\pi_1 + \pi_2 + \pi_3 + \pi_4 + \pi_5 = 1$, as follows, we get the simultaneous equations can be solved using a method to obtain definitive values of $\Pi = (\pi_1,\pi_2,\pi_3,\pi_4, \pi_5)$

## 6. RESULTS

From the analysis of the above equations &results, we have found that the values of Π are as follows

$\Pi = (\pi_1 = 0.210, \pi_2 = 0.431, \pi_3 = 0.170, \pi_4 = 0.126, \pi_5 = 0.063)$------(7)

From the results (7) we have stationary distributions of economic sectors of the country.

## 7. FINDINGS

We get Post-Covid-19 %, when the proportions are multiplied by the original the projected aggregate GDP amounts before the existence of Covid-19 virus. The totals are tabulated in the Table 4.

Table 4: Pre Vs Post-Covid-19 sector's contribution percentages to GDP

| **Economic Sector** | **Pre-Covid-19 %** | **Post-Covid-19 %** |
|---|---|---|
| Agriculture Sector | 15.57% | 13.62% |
| Banking & Insurance Sector | 15.1% | 27.81% |
| Manufacturing Sector | 16.0% | 11.01% |
| Infrastructure development Sector | 9.0% | 8.16% |
| Tourism Sector | 9.2% | 4.08% |

It is known from Table 4.that due to the Covid-19, the Manufacturing and Tourism sector were adversely affected. After that Agriculture and Infrastructure development Sectors were also affected. Whereas the Banking& Insurance Sectors has a high positive impact on Indian economic.A discussion about Way to going forward to different sectors is provided in the following lines.

Table 5: Main Reasons Vs. Way to going forward to Agriculture sector

| **Sector** | Agriculture Sector |
|---|---|
| **% of GDP**<br>**Pre Vs Post COVID-19** | 15.57%<br>↓ 13.62% |
| **Main Reasons** | 1) The non-availability of labors due to the curfew.<br>2) Inability to access markets due to issue in transportation and operation of markets due to the curfew. |
| **Way forward to** | 1) Enlarging harvesting technology.<br>2) The government should ensure farmers to getting easily sells their products at direct Procurement stations. |

Table 6: Main Reason Vs. Way to going forward to Manufacturing Sector

| **Sector** | Manufacturing Sector |
|---|---|
| **% of GDP**<br>**Pre Vs Post COVID-19** | 16.0%<br>↓ 11.01% |
| **Main Reason** | 1) A complete lockdown of all factories till more than two months. |
| **Way forward to** | 1) The government should give more concessions for running successfully to micro, small and medium enterprises after that curfew, especially allocate more funds to recover from lost production. |

Table 7: Main Reasons Vs. Way to going forward to Infrastructure development Sector

| **Sector** | Infrastructure development Sector |
|---|---|
| **% of GDP**<br>**Pre Vs Post COVID-19** | 9.0%<br>↓ 8.16% |

| | |
|---|---|
| **Main Reasons** | 1) The project sites all were closed, no new projects are admitted. The employers and employees an engineering, procurement and construction, transmission and distribution, road and building constructions, these people were unable to do perform tasks due to curfew.<br><br>2) Companies focus on employee and labor safety amidst corona virus pandemic is another reason for project commencements taking a back seat. |
| **Way forward to** | 1) The government is already under financial stress, but allocation funds for relief measures, which in turn, infrastructure sector in next 1-2 years will get positive impact.<br><br>2) The state and central governments and employers should need to ensure safety for labors and employees. |

Table 8: Main Reason Vs. Way to going forward to Tourism Sector

| **Sector** | Tourism Sector |
|---|---|
| **% of GDP**<br>**Pre Vs Post COVID-19** | 9.2%<br>↓ 4.08% |
| **Main Reason** | 1) Visas being suspended and tourist attractions being shut down indefinitely, the whole tourism value chain, which includes hotels, restaurants, agents and operators is expected to face losses worth thousands of crores. |
| **Way forward to** | 1) It is best to have a wait in this dangerous situation. Right after finished of the corona virus issues need to take remedial action |

Table 9: Main Reasons Vs. Way to going forward to Banking & Insurance Sectors

| **Sector** | Banking & Insurance Sector |
|---|---|
| **% of GDP**<br>**Pre Vs Post COVID-19** | 15.1%<br>27.81% ↑ |
| **Main Reasons** | 1) Foreign investors wish to invest in India; investors will approach India instead of china.<br><br>2) The insurance industry is generally well prepared for major loss events, including pandemics. |
| **Way forward to** | 1) India should take advantage of this great opportunity, should try to get more invests than china.<br><br>2) Actuaries need to create an insurance policy that is |

| | |
|---|---|
| | suited to the death and loss due to pandemic. |

## 8. CONCLUSION

Post Covid-19 has brought down the GDP rating of the country massively. All economic sectors are down side except Banking & Insurance Sectors. This paper aims to help the country to make proper planning options for its citizens in the post Covid-19 pandemic. This is also find the way to going forward techniques to various sectors as discussed above.

## 9. FUTURE PLAN

This research work will be done by the researcher using R-Programming in future.

## 10. REFERENCES

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