

## **IMPACT OF MACRO-ECONOMIC VARIABLES ON THE PRODUCTION OF THE PHARMACEUTICAL INDUSTRY IN INDIA**

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### **Abstract**

*The Indian pharmaceutical industry is renowned for the production of life-saving drugs at low cost, for which it is also referred to as the “lifeline industry.” The paper attempted to analyze the factors that are affecting the production of the Indian pharmaceutical industry. The study was conducted using secondary data of the Indian pharmaceutical industry from 2007 to 2019. Statistical tests such as the DW test, F test, and BP Godfrey test, along with other tests, have been used for robust analysis. The findings suggest that invested capital, viral hepatitis, and others have a positive impact, whereas the population has negatively impacted the production of the Indian pharmaceutical industry. The study recommends that more attention is required to be paid to the R&D section of the Indian pharmaceutical industry, which can help to develop the industry and reach its potential. Also, the study recommends the implementation of the “Make in India” initiative in the Indian medical device industry.*

**Keywords:** *Growth, Indian Economy, Health system, Pharmaceutical Industry.*

## **I. Introduction**

The Indian pharmaceutical sector is one of the most high-tech, research-oriented, and capital-intensive industries. It requires a huge amount of investment to acquire the latest technology due to its continuous development of new products and technologies, which have the potential to save billions of lives while improving their quality (Scherer, 2000). It is often referred to as the "lifeline" industry due to its significant contribution to the recovery of individuals suffering from diseases by providing life-saving drugs (Akhtar, 2013). The Indian pharmaceutical industry is the 3<sup>rd</sup> largest by volume and the 14<sup>th</sup> largest in terms of value (Akhtar, 2013). The magnitude of the Indian pharmaceutical industry can be measured by analyzing its supplies in the global market. India is a major global exporter of pharmaceutical goods, which has experienced significant growth in recent years, from a turnover of around US \$1 billion in 1990 to more than US \$30 billion by 2015, of which approximately US \$15 billion resulted from the exports (Department of Pharmaceuticals, 2018). India is also the major supplier of generic medicines in terms of volume; it supplies approx. 20% of the global need (Wikipedia, 2018).

According to the IBEF, the Indian pharmaceutical industry benefits from low production costs, which gives it an advantage while competing with other firms. India has the highest number of FDA-approved plants outside the USA. India is also a key player in the market for generic medicines. The Indian pharma industry produces high-quality medicines at an extremely low cost, which attracts consumers from all over the world. India is also known as the "Pharmacy of the World." The annual turnover of the Indian pharmaceutical industry during 2016-17 was ₹2,19,755 crores. The export value of

medicines and pharmaceutical products is ₹1,12,915.48 crores (Department of Pharmaceuticals, 2017-18). It also plays a significant role in creating jobs for millions of Indians. This industry stands out due to its unique feature of producing neither replaceable nor substitutable goods.

In this paper, an attempt has been made to identify the factors that are affecting the production of the pharmaceutical industry.

## **II. Literature Review**

The Indian pharmaceutical industry has experienced significant growth and challenges over the years. Post-World War II, medical advancements uplifted the industry (Scherer, 2000). However, the research and development (R&D) efforts by multinational companies (MNCs) were not able to help the Indian pharmaceutical companies because of restrictive policies (Feinberg & Majumdar, 2001). Promoting domestic R&D is essential for innovation (Pradhan, 2002), and while the Indian market is attractive globally (Joshi, 2003), industrial policies and TRIPS have driven R&D and growth (Kale & Little, 2007). Easy access and capital investment have created a smooth roadway for MNCs' entry, which has facilitated growth (Greene, 2007). Significant enhancement of R&D and API production resulted in a boost in foreign exchange (Kiran & Mishra, 2009). During the post-liberalization period, R&D expenditure increased to a great extent (Saranga & Banker, 2010). Patent reforms initially encouraged R&D investment but eventually hindered it due to high failure rates. (Joseph, 2012). Productivity relies heavily on R&D (Sharma, 2012), with factors such as skilled labor and low production costs driving the industry's growth (Akhtar, 2013). Various economic factors significantly affect the financial performance of the EU and Colombian pharma

markets (Boldeanu & Pugna, 2014; Barbosa et al., 2016). Many of the previous studies have mentioned the importance of the pharmaceutical sector in the Indian context. Overall, the studies have focused on the role of R&D, Patent and various other factors in the Indian pharmaceutical industry.

### **III. Objectives of the Study and Research Methodology**

The study attempted to analyse the factors affecting the production of Indian pharmaceutical industry. The study is empirical in nature and involves analysis using secondary data. The time period of the study is from 2007 to 2019, which was selected based on macro-economic conditions, that is from the great recession to the year prior to the COVID-19 pandemic. The secondary data was gathered from the economic outlook database, the India Brand Equity Foundation database, the database of the Department of Pharmaceuticals, and various published research papers. Collected data was analysed using multivariate regression analysis. In addition to that, various statistical tests such as the Jarque-Bera test, the Breusch-Pagan-Godfrey test, the Durbin-Watson test, the multi-collinearity test, etc. have been used for robust analysis. The regression model comprises a dependent variable, production (P), representing the total production in the Indian pharmaceutical industry. the model involves various independent variables such as: Capital invested (IC), denoting the total capital invested in the Indian pharmaceutical industry. In addition to this, various diseases such as Cholera Outbreak(CO), representing the occurrences of cholera outbreaks in India; Acute Respiratory Infection and Viral Hepatitis (VH), reflecting the total count of people suffering from Acute Respiratory Infection and viral hepatitis, were incorporated in the model. Alongside these, Population (PN), indicating the total population of India also plays a major role in the production of the pharmaceutical industry.

The total number of road accidents in India (TRA), denoting individuals injured in road accidents and Investment in health structures (IHS), representing the overall investment in the Indian health structure were included in the model. Additionally, the symbol  $\epsilon$  stands for the error term, representing the unexplained variation in the dependent variable attributed to factors not accounted for by the explanatory variables.

Therefore, the regression model is:

$$P = \alpha + \beta_1 IC + \beta_2 ARI + \beta_3 CO + \beta_4 PN + \beta_5 TRA + \beta_6 VH + \beta_7 IHS + \epsilon$$

#### IV. Analysis & Discussion

**Table I: Variance Inflation Factor**

Variable	VIF
Invested capital (IC)	7.88
Acute Respiratory Infection (ARI)	9.29
Cholera outbreak (CO)	3.32
Population (PN)	1.29
Total number of people injured in road accidents (TRA)	2.03
Viral Hepatitis (VH)	3.34
Investment in health structure (IHS)	3.72

Table I checks whether the estimated model is suffering from multicollinearity, which arises when the explanatory variables are highly correlated among themselves. The analysis is done by checking the variance inflation factor. From the above table, we've found that the value of VIF is less than 10 for

each variable, which suggests that most likely, our model is not suffering from any kind of problem regarding multicollinearity.

**Table II: R<sup>2</sup> and Adjusted R<sup>2</sup>**

R <sup>2</sup>	90.9%
Adjusted R <sup>2</sup>	89.4%

Table II, indicates that coefficient of determination (R<sup>2</sup>) is 0.909, i.e., 90.9%, which means that 90.9% of the total variance in the production of the pharmaceutical industry is explained by the explanatory variables, which indicates our model is satisfactory and independent variables can explain a sizeable variance in the dependent variable, i.e., the total production of the pharmaceutical industry.

Autocorrelation arises when there is a correlation among the successive values of a single variable. In this model, the value of the Durbin-Watson test is 2.26, which is very close to the value of 2. This result helps to assume that there may not be a problem of autocorrelation.

**Table III: F-test for the significance of Regression**

F-statistic	41860.44
Prob (F-statistic)	0.003763

Table III indicates the value of the F statistic is 41860.44 with a P value of 0.003763, which is significant at a 99% confidence level. This means our regression model is significant. This also suggests that a significant influence of the multiple regression model occurs over the dependent variable.

**Table IV: Jarque-Bera test**

Jarque-Bera value	0.69
Probability	0.71

Table IV shows the value of Jarque-Bera is 0.69, where the probability is 0.71, which is more than 5%, indicating that the null hypothesis is accepted, which means the residual is following the normal distribution.

**Table V: Augmented Dicky-Fuller Unit Root Test for Stationarity of Data**

Variable	Level of difference	t-statistics of ADF test	Prob. Of ADF test
Production (P)	1 <sup>st</sup>	-5.074471	0.0027
Invested capital (IC)	1 <sup>st</sup>	-6.951560	0.0002
Acute Respiratory Infection (ARI)	2 <sup>nd</sup>	-3.324272	0.0456
Cholera outbreak (CO)	1 <sup>st</sup>	-4.56569	0.0109
Population (PN)	1 <sup>st</sup>	-3.651701	0.0288
Total number of people injured in road accidents (TRA)	1 <sup>st</sup>	-4.408643	0.0073
Viral Hepatitis (VH)	1 <sup>st</sup>	-5.352983	0.0018
Investment in health structure (IHS)	2 <sup>nd</sup>	-4.375282	0.0089

Table V indicates that the unit root test was conducted to check whether the data is stationary or not. For this purpose, the augmented Dickey-Fuller test statistic has been used. The t-test values along with the probability of the ADF test show that all the variables are significant at 1%, which indicates that the data is stationary and is not suffering from the unit root.

**Table VI: Breusch-Pagan-Godfrey Heteroscedasticity Test**

F-statistics	0.438159
Prob. F (7,1)	0.8254

Table VI shows the heteroscedasticity test, which has been checked by the Breusch-Pagan-Godfrey test. The p-value is more than 5%, i.e., 0.8254, which suggests that the null hypothesis is accepted and concludes that the model is not suffering from heteroscedasticity.

**The Regression equation:**

$$P = 1.800834 + 0.620128IC + 0.016363ARI + 0.6176133CO - 0.003661PN + 0.185179TRA + 0.282929VH + 9.683176IHS + \epsilon$$

**Table VII: Regression Results**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$\alpha$	1.800834	0.03129304	57.54743	0.0111
Invested capital (IC)	0.620128	0.005931	104.5571	0.0061
Acute Respiratory Infection (ARI)	0.016363	0.000207	79.04831	0.0081
Cholera outbreak (CO)	0.6176133	0.00615012	100.4229	0.0063
Population (PN)	-0.003661	0.000198	-18.4899	0.0343
Total number of people injured in road accidents (TRA)	0.185179	0.022297	8.305108	0.0763
Viral Hepatitis (VH)	0.282929	0.01538	18.3959	0.0346
Investment in health structure (IHS)	9.683176	0.1149542	84.23508	0.0076

Table VII shows the result of the regression analysis. The coefficient of the constant is 1.800834, along with the t value of 57.54744 and standard error of 0.03129304 which is statistically significant at the 1% level. The result indicates that even if the explanatory variables are not included in the model still the production of the pharma industry will be 1.800834 units. This suggests, there are some other factors that are affecting the production of the Indian pharmaceutical industry which are not incorporated into our regression model. Also, the coefficient of invested capital (IC) is 0.620128, with t-value of 104.5647, which is statistically significant at the 1% level. The result indicates that capital invested in the pharmaceutical industry has a positive impact on the production, which might also lead to the enhancement of the company's profit. The study has found the traces of certain diseases which has significantly impacted the production of pharmaceutical industry. Diseases such as, Acute respiratory infection (ARI) is statistically significant at 1% level with the coefficient of 0.016363, and the t-value is 79.04335, indicating that as acute respiratory infection increases, the need for pharmaceutical products will enhance too, and ultimately, result in increase in production of pharmaceutical products. In addition to that, Cholera Outbreak (CO) in India also plays a vital role in the production of the pharmaceutical industry in India. The result indicates a positive impact of the cholera outbreak in India on the production of pharmaceutical products. The coefficient of cholera outbreak is 0.6176133, and the t-value is 100.4229, which is statistically significant at the 1% level. The result indicates that the higher the number of cholera outbreaks, has led to increase in the requirement of the pharmaceutical products. The production of the pharmaceutical industry in India has also been impacted by the number of people suffering from viral hepatitis (VH)

in India. Viral hepatitis (VH) is one of the major diseases in India. The result shows that the coefficient is 0.282929, where the t-value is 18.3959. This result indicates that the increase of number of people suffering from viral hepatitis (VH) disease has a positive impact on the production of the pharmaceutical industry in India. As the number of viral hepatitis (VH) patients increases, it creates a positive impact on the production of the pharmaceutical industry. Another key factor that helps determine the production of the Indian pharmaceutical industry is the population of India. The demand of pharma products is highly and positively correlated with the population. But the result suggest that the population of India has a negative coefficient, which is -0.003661, where the value of t is -18.4899. This variable is statistically significant at the 5% level, which implies that the rise in population has a negative impact on the production of pharmaceutical products in India. This result can be a reflection of the great recession that occurred at the end of 2007 and came to its full fledge in 2008. As the production has declined due to the recession, global demand has fallen to some extent, which may be causing this result. Another reason for this result may be that as the population increases, the health budget may not increase at the same rate. As a result, many Indians are not able to access health care facilities, as a vast portion of Indians are below the poverty line, which creates a major drawback for the Indian health system. Additionally, the total number of people injured in road accidents (TRA) also plays a major role in defining the production of the pharmaceutical industry in India. The coefficient value is 0.185179, and the t-value is 8.305084. This result is significant at the 10% level of significance. This positive result reflects that as the number of injured persons increases, the need for pharmaceutical products will also increase. Finally, this will push

up the production of pharmaceutical products in India. Other than all of these, Investment in health structure (IHS) is the final variable that has been included in the model. The coefficient of investment in health structure (IHS) is 9.683176, and the associated t-value is 84.23508, which is statistically significant at the 1% level. This result reflects that higher investment in the health structure means connecting more people to the health system by providing health services to the Indian citizens. This will uplift the demand for pharmaceutical products, which will ultimately lead to a rise in the production of the Indian pharmaceutical industry.

## **V. Conclusion**

Over the years, the Indian pharmaceutical industry has emerged with the help of various schemes launched by the state governments and the Central Govt. of India, such as “Swasthya Sathi” by the Govt. of West Bengal, which was launched in 2016, “Karunya Arogya Suraksha Padhathy, launched by the Govt. of Kerala in 2012, and “Ayushman Bharat,” which was launched in 2018 by the Govt. of India. But there are some serious concerns which is required to be answered. Import percentage of Indian Medical Device Industry is almost 65% which can be reduced only by developing a stable ecosystem and innovation cycle and ‘Make in India’ initiative can play a vital role. In addition to this, increase in chronic disease from 45% in 2010 to 75% in 2025 (estimated by Department of Pharmaceuticals) can play a vital role in the growth of the pharma sector. Additionally, high penetration of health insurance i.e., \$3.9 billion (2015) to estimated \$8 billion (2020) and the growth of medical tourism which is expected at a CAGR of 30% from \$2.8 billion in 2014 to \$10.6 billion in 2019; can enhance the growth of the pharma sector (Department of Pharmaceuticals, 2018). The sector has a huge growth

opportunity as the population is growing which can be almost 1,360 million in 2021 (estimated). Finally, the aging population can a major role in enhance the growth of the sector as it was 5.3% in 2011 to 6% in 2021 (estimated) (Department of Pharmaceuticals, 2018). Due to low cost and high quality, the products produced by the Indian pharmaceutical industry are very much appreciated and renowned around the world, but due to low investment in research and development, the industry is not able to reach its potential. By concentrating more on this issue, pharma industry can touch a new height of success.

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