**DETERMINANTS OF OUTPUT IN INDIAN MANUFACTURING INDUSTRIES: A PANEL DATA ANALYSIS**

**Abstract:** India's manufacturing industry is a major employer and contributor to GDP, making it an essential part of the country's economy. For sustainable economic growth, it is essential to comprehend the factors that influence output in this industry. This research uses panel data analysis to look into the factors that affected production over an 11-year period from 1990 to 2000 in 11 manufacturing industries in India. To make sure the conclusions are robust, the analysis consists of cointegration analysis and unit root testing. The results show that a number of variables, including the total number of personnel involved, the total amount of inputs, depreciation, and net value added, significantly affect the output levels. Additionally, the analysis finds that there is cointegration and cross-sectional dependency among the variables. These results offer insightful information that can help advance the growth and development of India's industrial industry, which will ultimately contribute in the country's economic growth and development.

**Keywords**: Panel data analysis, Output determinants, Fixed effects model, Random effects model, Cointegration analysis, Unit root test, etc.

**1. INTRODUCTION**

The manufacturing sector of India is crucial to the country's economic growth since it generates a substantial amount of employment and the GDP. In order to promote sustainable economic growth, stakeholders and policymakers must have a thorough understanding of the factors that influence output in this industry. In this regard, panel data analysis provides an effective framework for examining the variables affecting production in various manufacturing sectors.

The primary goal of this study is to investigate the factors that influence output in 11 Indian manufacturing industries. The value of output, which is the dependent variable, is regressed on a number of independent variables, such as the total persons engaged, total inputs, depreciation and net value added.

In India's manufacturing sectors, the total persons engaged, total inputs, depreciation and net value added are all important factors that influence the value of output. Since labor is the fundamental component of production, the total number of persons engaged represents the labor input, and a higher number of persons engaged generally translates into higher output levels. In a similar way, total inputs include all of the resources needed for production, including raw materials, energy, and capital. Higher output levels are usually the consequence of increasing production capacity and efficiency, which is brought about by higher total inputs. Depreciation is a measure of how capital assets deteriorate over time.

Increased investment in capital assets may be indicated by higher depreciation rates, and this could result in higher output levels. The value produced by the production process, which directly influences output levels, is measured by net value added. As a result, the total number of employees, total amount of inputs, depreciation and net value added are all positively correlated with the levels of output in India's industrial sectors.

We may take into account both cross-sectional and time-series fluctuations in the data by using panel data analysis, which results in estimates of the relationships between the dependent and independent variables that are more robust and accurate.

Unit root tests and cointegration analysis are also included in this study to address concerns about non-stationarity and the long-term correlations between the variables. Cointegration analysis looks at if there are any long-term correlations between the variables, whereas unit root tests assist determine whether the variables are stationary.

The main goal of this study is to use panel data analysis techniques to identify the major output factors in Indian manufacturing industries and to evaluate their relevance. Policymakers, industry professionals, and scholars interested in promoting the expansion and development of India's manufacturing sector should find significant benefit from the findings of this study.

**2. LITERATURE REVIEW**

Using information from previous studies, the literature review investigates the factors that influence manufacturing sector production. Using panel regression analysis, Chakraborty and Ghose (2017) looked into the rise of output and its factors in the Indian pharmaceutical sector. Their research showed a strong correlation between output growth and variables including the total number of employees, the total amount of inputs, depreciation, net value added, and profits. In a similar vein, Ogundipe and Olarewaju (2020) investigated worker productivity and manufacturing output in the Economic Community of West African States (ECOWAS). Total persons engaged, total inputs, and profits were found to be major predictors of output growth and labor productivity by their panel regression study. These studies offer insightful information about the variables affecting manufacturing industry output.

**3. RESEARCH GAP**

The studied literature offers significant insights into the factors influencing manufacturing industry output, especially when considering India and the ECOWAS area. Nevertheless, there is a clear research vacuum when it comes to the factors that influence output, particularly in Indian manufacturing businesses that use cointegration, panel data analysis, and unit root testing. Research concentrating on the thorough examination of production factors across multiple industrial sectors in India is lacking, despite several studies looking at them in the context of the ECOWAS region and the Indian pharmaceutical industry. Moreover, unit root testing and cointegration analysis have not been used in any of the examined research to address problems with non-stationarity and the long-term interactions between variables. Consequently, the purpose of this work is to close this gap by employing a thorough panel data statistical approach, which includes panel regression, unit root tests and cointegration techniques, to investigate the output determinants in 11 manufacturing industries in India. In doing so, this study aims to contribute to the body of knowledge and the development of relevant policies by offering a more thorough understanding of the variables influencing production in the industrial sectors of India.

**4. OBJECTIVES OF THE STUDY**

The objectives of this paper are as follows:

1) To examine the determinants of output in 11 manufacturing industries in India.

2) To investigate the relationship between the logarithm of output value and the logarithms of total persons engaged, total inputs, depreciation, net value added, and profits.

3) To incorporate unit root tests to identify the stationarity of variables and cointegration analysis to examine the long-term relationships among them.

**5. MATERIALS**

**5.1 SOURCES OF DATA**

The data used in this study was collected annually for 11 manufacturing industries over an 11-year period from 1990 to 2000, and they came exclusively from secondary sources. The Ministry of Statistics and Program Implementation (MoSPI) provided the Annual Survey of Industries, from which the statistics were gathered. The time series data was analyzed using STATA 17 software for data analysis.

The database of the study is drawn from Annual Survey of Industries (ASI), which based on the National Industrial Classification NIC-1987 and NIC-1998. The method of arrangement of the database has been explained in **Table 1**.

**Table 1**: Classification of Industries

|  |  |  |
| --- | --- | --- |
| **NAME OF THE INDUSTRY** | **NIC 1987 (TWO DIGIT)** | **NIC 1998  (TWO DIGIT)** |
| MANUFACTURE OF FOOD PRODUCTS, BEVERAGES, TOBACCO & RELATED PRODUCTS | 20-21+22 | 15+16 |
| MANUFACTURE OF TEXTILES & TEXTILE PRODUCTS | 23+24+25+26 | 17+18 |
| MANUFACTURE OF WOOD PRODUCTS, FURNITURES & FIXTURES | 27 | 20+36 |
| MANUFACTURE OF PAPER & PAPER PRODUCTS & PRINTING | 28 | 21+22 |
| MANUFACTURE OF LEATHER, LEATHER PRODUCTS, FUR | 29 | 19 |
| MANUFACTURE OF BASIC CHEMICALS AND CHEMICAL PRODUCTS | 30 | 24 |
| MANUFACTURE OF RUBBER, PLASTIC, PETROLEUM & COAL PRODUCTS, PROCESSING NUCLEAR FUELS | 31 | 23+25 |
| MANUFACTURE OF NON-METALLIC MINERAL PRODUCTS | 32 | 26 |
| MANUCTURE OF BASIC METALS & ALLOY INDUSTRIES, METAL PRODUCTS & PARTS | 33+34 | 27+28 |
| MANUFACTURE OF MACHINERY & EQUIPMENT | 35+36 | 29+30+31+32+33 |
| MANUFACTURE OF TRANSPORT EQUIPMENT & PARTS | 37 | 34+35 |

Source: Central Statistical Organization

**5.2 VARIABLES USED FOR ANALYSIS**

**Dependent Variable**: Value Of Output

**Independent Variables**: Total Persons Engaged, Total Inputs, Depreciation and Net Value Added

**6. METHOD USED**

**6.1 TECHNICAL CONSIDERATIONS**

**6.1.1 THE FIXED EFFECTS LEAST-SQUARE DUMMY VARIABLE REGRESSION MODEL**

The **Fixed Effects regression model** is used to estimate the effect of intrinsic characteristics of individuals in a **panel data set**. A fixed effect regression model indicates that each unit has its own intercept. There will be heterogeneity among the units due to individual intercepts. Here, in the fixed effect model, the unit intercepts are time-invariant (do not vary over time) even if they might be different among cross-sectional units. However, the fixed effect model believes that the coefficients of the independent variables do not vary across cross-sectional units or over time. These fixed effects models can be implemented with the dummy variable technique.

**6.1.2 THE RANDOM EFFECTS MODEL**

The random effects model is also called the error component model (ECM). In this model, the cross-sectional units will have random intercepts instead of fixed intercepts. The rationale behind the random effects model is that, unlike the fixed effect model, the variation across entities is assumed to be random and uncorrelated with the predictor or independent variables included in the model. The crucial distinction between the fixed and random effects is whether the unobserved individual effects embody elements that are correlated with regressors in the model, not whether these effects are stochastic or not.

**6.1.3 THE HAUSMAN TEST**

The Hausman test is the standard procedure used in empirical panel data analysis to distinguish between fixed effects and random effects. In the Hausman test, the null hypothesis signifies that there is no significant difference in the estimator of the fixed effect model and random effect model. If we reject the null hypothesis, the fixed effect model will be the appropriate model. Rejecting the null hypothesis shows that there might be a correlation between the error term and dependent variable.

**6.1.4 TESTING FOR CROSS-SECTIONAL DEPENDENCE**

The impact of cross-sectional dependence in dynamic panel estimators is more severe. Testing for cross-sectional dependence is important in fitting panel-data models. Cross-sectional dependency test in panel data is crucial to ensure the validity of the analysis. One widely used test for cross-sectional dependency is the Pesaran CD test, developed by Pesaran in 2004. The Pesaran CD test examines the presence of cross-sectional dependence in panel data. It is based on the correlation of the residuals obtained from the estimation of individual-specific effects. The test statistic is given by:

Where:

is the residual from the individual-specific effect estimation.

T is the number of time periods.

N is the number of cross-sectional units.

h is the lag order.

The Pesaran CD test is a lagged correlation test, where the correlation between the residuals is computed for different lag orders h. Consider the standard panel-data model:

Under the null hypothesis, is assumed to be independent and identically distributed (i.i.d.) over periods and across cross-sectional units.

Under the alternative, may be correlated across cross sections

for some

**6.1.5 UNIT ROOT TEST**

The Pesaran's CADF test is based on the individual augmented Dickey-Fuller (ADF) regression for each cross-sectional unit in the panel data. The test statistic is then computed by pooling the individual ADF statistics. The CADF test statistic is given by:

Where:

is the estimated first-order autocorrelation coefficient from the individual ADF regression for cross-sectional unit 𝑖.

T is the number of time periods.

N is the number of cross-sectional units.

The null hypothesis of the CADF test is that the individual series contain a unit root. If the computed test statistic exceeds the critical value, the null hypothesis is rejected, indicating that the series is stationary.

The Pesaran's CADF test is a powerful unit root test for panel data that accounts for cross-sectional dependence among the panel units. By considering the presence of cross-sectional dependency, the CADF test provides more reliable results compared to traditional unit root tests, ensuring the validity of panel data analysis.

**6.1.6 TESTS FOR COINTEGRATION**

Kao (1999) considered static fixed effects model and use residuals of pooled ADF regression. If ∼ I(1) we cannot reject H0 of no cointegration, if ∼ I(0) reject H0. Kao’s tests are rather restrictive on cointegrating vector.

Pedroni (1999) and Pedroni (2004) used residuals tests in the Engle-Granger tradition. Pedroni used group mean and panel statistics. Pedroni (1999, 2004) introduced seven test statistics

• test the null hypothesis of no cointegration in nonstationary panels.

• allow heterogeneity in the panel,

• both in the short-run dynamics as well as in the long-run slope and intercept coefficients.

This test provides evidence for cointegration in the panel among two or more variables. The test statistics are grouped into two categories:

• group-mean statistics and

• panel statistics.

The panel ρ statistic used in this test is an extension of the non-parametric Phillips-Perron ρstatistic, and the parametric panel t statistic is an extension of the ADF t-statistic. Between-dimension-based statistics are the group mean approach extensions of the within-dimension-based ones.

The Westerlund (2007) panel cointegration test is designed to determine the presence of cointegration in panel data. Unlike the Pedroni test, it allows for heterogeneity in both the intercept and slope coefficients across cross-sectional units. The test is conducted in two steps.

First, the test estimates the within-dimension augmented Dickey-Fuller (ADF) regression for each individual unit. Then, it applies cross-sectional dependence (CD) and time-series dependence (TD) robust statistics to test the null hypothesis of no cointegration. The advantage of the Westerlund test lies in its ability to account for cross-sectional and time-series dependencies, common in panel datasets.

Westerlund provides two types of statistics: the t-bar statistic and the F-bar statistic. The t-bar statistic tests for individual cointegration, while the F-bar statistic tests for group (or panel) cointegration. Critical values for these statistics are provided to determine the significance of the cointegration relationship.

**6.1.7 MODEL SPECIFICATION**

The panel data analysis in this research examines the relationship between the log of output value and various independent variables across 11 manufacturing industries in India. The model specification includes fixed effects, random effects, and a Hausman test to determine the appropriate model. Additionally, unit root tests and cointegration analysis are conducted to ensure the robustness of the results. The model can be specified as follows:

Where:

represents the log of output value of the ith industry at time t.

denote the log of total persons engaged, log of total inputs, log of depreciation, and log of net value added respectively for the ith industry at time t.

are the coefficients to be estimated.

is the error term.

Fixed effects and random effects are incorporated to control for unobserved heterogeneity across industries. The Hausman test is employed to determine which model (fixed effects or random effects) is more appropriate. Unit root tests and cointegration analysis are conducted to ensure the time series properties and long-run relationship among variables.

**7. RESULTS AND DISCUSSION**

**7.1 DESCRIPTIVE STATISTICS RESULTS**

**Table 2** gives a summary of descriptive statistics of the explanatory variables and the dependent variable.

**Table 2:** Summarized Descriptive Statistics

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **VARIABLES** | **OBS.** | **MEAN** | **STD. DEV** | **MIN** | **MAX** |
| ln\_valueofoutput | 121 | 14.74476 | 1.292754 | 11.31963 | 16.58563 |
| ln\_totalpersonsengaged | 121 | 13.08221 | 0.96261 | 11.11804 | 14.48493 |
| ln\_totalinputs | 121 | 14.4863 | 1.30006 | 11.10199 | 16.42608 |
| ln\_depriciation | 121 | 11.31367 | 1.364747 | 7.751475 | 13.49541 |
| ln\_netvalueadded | 121 | 13.0659 | 1.282231 | 9.522959 | 15.08046 |

**Table 2** reveals that the minimum of log of value of output is 11.31963 and the maximum is 16.58563. The mean of log of value of output is 14.74476 and standard deviation is 1.292754. Similarly, the mean, standard deviation, minimum and maximum of log of total persons engaged, log of total inputs, log of depreciation and log of net value added are also presented in the table. Understanding the central tendency, variability, and range of the variables—all of which are critical for comprehending the features of the industrial industries under investigation—is made possible by these summary statistics.

**7.2 TRENDS OF VALUE OF OUTPUT IN INDIAN MANUFACTURING INDUSTRIES**

From the **Figure 1** we can see that for the years 1990 to 2000, the value of output in India's manufacturing industries followed a steady and noteworthy growth pattern. The value of output has significantly increased over this time in a number of manufacturing sectors.

This positive trend has been facilitated by a number of factors. First, the early 1990s economic liberalization of India brought with it an increase of foreign investment, advances in technology, and increased competition, all of which fueled the expansion of the manufacturing industry.

Second, expansion and investment in the manufacturing industries have been significantly fueled by government attempts to promote industrialization, such as the creation of Special Economic Zones (SEZs) and the introduction of favorable laws and incentives.

Third, the industrial sector is now more efficient and competitive because of advancements in logistics, transportation, and infrastructure that have made it easier to move goods and services.

The demand for manufactured goods in the country has also increased due to positive demographic trends, such as a growing middle class and population, which has increased output and production in the manufacturing sectors.

In general, the evolution of the value of output in India's manufacturing industries between 1990 and 2000 indicates a time of consistent growth and development, marked by higher levels of investment, production, and industry competitiveness.

We can also see from the **Figure 1** that the log of value of output for the industry of the Manufacture of Transport equipments and parts exhibits a sudden decline followed by a sudden upward trend. This trend could be attributed to changes in government policies, technological advancements, or market demand fluctuations within the transportation sector.

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**Figure 1:** Industry-wise trend Line of Log of Value of Output

**7.3 PANEL REGRESSION RESULTS**

**7.3.1 FIXED EFFECT MODEL**

The results presented in **Table 3** reveals that there were 121 cases or rows and 11 groups or entities present in the data. The result of the F-test has come out to be less than 0.05 and is highly significant which means the data is good. The result also reveals that the error terms ui are positively correlated with the regressors in the fixed effects model. The coefficients of regressors indicates that log of value of output changes by -0.7 times when log of total persons engaged changes by one unit. Similarly, log of value of output changes by 77% when log of total inputs changes by one unit, 3.3% when log of depreciation changes by one unit and 19% when log of net value added changes by one unit. There is a 71.09% of the variance due to differences across panels. The p values is lower than 0.05 for 95% confidence interval which means that all the independent variables have a significant influence on the dependent variable.

**Table 3**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **FIXED EFFECT MODEL** | | | | |
| **VARIABLES** | **COEFFICIENT** | **STD. ERROR** | **t** | **P>t** |
| ln\_totalpersonsengaged | -0.007321 | 0.0033945 | -2.16 | 0.033 |
| ln\_totalinputs | 0.7792398 | 0.0054775 | 142.26 | 0.000 |
| ln\_depriciation | 0.0329391 | 0.003412 | 9.65 | 0.000 |
| ln\_netvalueadded | 0.189885 | 0.003646 | 52.08 | 0.000 |

**7.3.2 RANDOM EFFECT MODEL**

The results presented in **Table 4** reveal that there were 121 cases or rows and 11 groups or entities present in the data. The result of the Wald chi2 has come out to be less than 0.05 and is highly significant which means the data is good. The result also reveals that the differences across units are uncorrelated with the regressors in the random effects model. The p value is lower than 0.05 for 95% confidence interval which means that the independent variables have a significant influence on the dependent variable except in the case of log of total persons engaged.

**Table 4**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **RANDOM EFFECT MODEL** | | | | |
| **VARIABLES** | **COEFFICIENT** | **STD. ERROR** | **t** | **P>t** |
| ln\_totalpersonsengaged | -0.003525 | 0.0025293 | -1.39 | 0.163 |
| ln\_totalinputs | 0.7792053 | 0.0044465 | 175.24 | 0.000 |
| ln\_depriciation | 0.0329255 | 0.0028905 | 11.39 | 0.000 |
| ln\_netvalueadded | 0.189241 | 0.0033525 | 56.45 | 0.000 |

**7.3.3 HAUSMAN TEST**

Hypothesis for the Hausman test;

H0: The random effects model is consistent and efficient.

H1: The fixed effects model is consistent and efficient.

The results of the Hausman test has been presented in **Table 5**. It has been interpreted from the result that the random effect is more suitable for the data since the result is more significant for that model.

**Table 5**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **HAUSMAN TEST** | | | | |
| **VARIABLES** | **FE** | **RE** | **DIFFERENCE** | **STD. ERROR** |
| ln\_totalpersonsengaged | -0.007321 | -0.003525 | -0.003796 | 0.0022639 |
| ln\_totalinputs | 0.7792398 | 0.7792053 | 0.0000344 | 0.0031986 |
| ln\_depriciation | 0.0329391 | 0.0329255 | 0.0000136 | 0.0018130 |
| ln\_netvalueadded | 0.189885 | 0.189241 | 0.000644 | 0.0014332 |
| Prob > chi2 = 0.3911 | | | | |

**7.4 CHECKING FOR PRESENCE OF CROSS-SECTIONAL DEPENDENCY**

Hypothesis for checking cross-section dependency;

H0: No cross-sectional dependence

H1: Presence of cross-sectional dependence

From the **Table 6**, we can see that the P-value for all the variables are significant and so the null hypothesis can be rejected. So, we accept the alternative hypothesis and hence it is concluded that there is presence of cross-sectional dependence in all the series of variables.

**Table 6:** Test for Cross-sectional Dependency

|  |  |  |
| --- | --- | --- |
| **VARIABLES** | **CD-test** | **P-value** |
| ln\_valueofoutput | 21.61 | 0.000 |
| ln\_totalpersonsengaged | 10.003 | 0.000 |
| ln\_totalinputs | 21.623 | 0.000 |
| ln\_depriciation | 21.978 | 0.000 |
| ln\_netvalueadded | 20.407 | 0.000 |

**7.4 ANALYSIS OF THE SERIES STATIONARITY**

Earlier, we have seen the presence of cross-sectional dependency in all the variables so we need to check for second generation unit root tests. Here, I have done the unit root test using the Pesaran Cross section-specific Augmented Dickey–Fuller (CADF) statistic. It carries out t-test for unit roots in the presence of cross-sectional dependence where cross section units are heterogeneous. As the series exhibits trend, we incorporate the trend component in the ADF equation to carry out this test.

Hypothesis for the unit root test;

H0: Variables are not stationary (variables have Unit root).

H1: Variables are stationary (variables have no unit root).

**Table 7**: Unit Root at 95% level of confidence

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **VARIABLES** | **t-bar** | **Critical Value at 5%** | **P-value** | **Lags** |
| ln\_valueofoutput | -0.128 | -2.82 | 1.000 | 1 |
| ln\_totalpersonsengaged | -1.418 | -2.82 | 0.994 | 1 |
| ln\_totalinputs | -0.611 | -2.82 | 1.000 | 1 |
| ln\_depriciation | -1.646 | -2.82 | 0.967 | 1 |
| ln\_netvalueadded | -1.076 | -2.82 | 1.000 | 1 |

From **Table 7**, we can say that the critical values of the t-bar statistic given in the output suggest that we fail to reject the null. Also, the P-value is insignificant in each case so it confirms that the null hypothesis is rejected. Hence, there is presence of unit root in the series of all the five variables.

**7.5 COINTEGRATION TESTS**

I have done three tests for checking the presence of cointegration in the data: Kao, Pedroni and Westerlund using the xtcointtest command. For Kao and Pedroni:

H0: No Cointegration

H1: All Panels are Cointegrated

**Table 8** shows the result of Kao test for Cointegration using 5 summary statistics : Dickey–Fuller, Modified Dickey–Fuller, Augmented Dickey–Fuller, Unadjusted Dickey–Fuller and Unadjusted modified Dickey–Fuller. The p-values for all these five statistics are significant (<0.05) and hence we reject the null hypothesis of no cointegration. We can conclude that there is presence of cointegration relation among the variables or there is a presence of long-run relationship among the variables. In **Table 9**, we can see the results of Pedroni test for cointegration using 3 summary statisitics: Modified Phillips–Perron t, Phillips–Perron t and Augmented Dickey–Fuller t. In this case also we can see similar results since the P-values are significant (<0.05) so this results also suggests the presence of cointegration between the variables.

**Table 8**

|  |  |  |
| --- | --- | --- |
| **Kao test for cointegration** | | |
|  | **STATISTIC** | **P-VALUE** |
| Modified Dickey–Fuller t | 2.8462 | 0.0022 |
| Dickey–Fuller t | 2.4571 | 0.0070 |
| Augmented Dickey–Fuller t | 3.5964 | 0.0002 |
| Unadjusted modified Dickey–Fuller t | -6.0775 | 0.0000 |
| Unadjusted Dickey–Fuller t | -6.2743 | 0.0000 |

**Table 9**

|  |  |  |
| --- | --- | --- |
| **Pedroni test for cointegration** | | |
|  | **STATISTIC** | **P-VALUE** |
| Modified Phillips–Perron t | 4.582 | 0.0000 |
| Phillips–Perron t | -12.8117 | 0.0000 |
| Augmented Dickey–Fuller t | -7.9428 | 0.0000 |

On the other hand, for Westerlund:

H0: No Cointegration

H1: Some Panels are Cointegrated

In **Table 10**, we can see the results of Westerlund test for cointegration. The P-value is Significant in this case also denoting that there is presence of cointegration among the variables.

**Table 10**

|  |  |  |
| --- | --- | --- |
| **Westerlund test for cointegration** | | |
|  | **STATISTIC** | **P-VALUE** |
| Variance Ratio | 2.8436 | 0.0022 |

**8. CONCLUSION**

This study uses panel data analysis to examine the factors influencing output in 11 manufacturing industries in India. The findings imply that depreciation, net value added, total persons engaged, and total inputs are important variables affecting the value of output in these industries. There were two models used: fixed effects and random effects. The Hausman test suggested that the random effects model was the more appropriate one. All variables also showed cross-sectional dependency, and unit root tests verified that the series had unit roots. Cointegration tests, such as the Pedroni, Westerlund, and Kao tests, showed that there was cointegration between the variables, indicating a long-term link. These results offer insightful information to academics, businesspeople, and legislators, assisting in the creation of successful plans to encourage the expansion of Indian manufacturing sector. By employing robust panel data analysis techniques, this study contributes to a more thorough understanding of the factors influencing production in India's industrial sectors and lays the groundwork for further research and policy development aimed at fostering sustainable economic growth.

**9. REFERENCES**

1. Adeyemi A. Ogundipe & Favour O. Olarewaju, "Manufacturing Output and Labour Productivity: Evidence from ECOWAS ", Academic Journal of Interdisciplinary Studies ISSN 2281-3993 Vol 9 No 5 September 2020

<https://www.researchgate.net/publication/345333345_Manufacturing_Output_and_Labour_Productivity_Evidence_from_ECOWAS>

2. Chandrima Chakraborty & Arpita Ghose, "Growth of Output and its Determinants in Indian Pharmaceutical Industry: Evidence from a Panel Regression", The Journal of Industrial Statistics (2017), 6 (1), 108 – 122

<https://mospi.gov.in/sites/default/files/reports_and_publication/NSS_Journals/jr7_6_1March2017.pdf>