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A Comparative Study on Performances of Manufacturing Sector with Printing Industry of India

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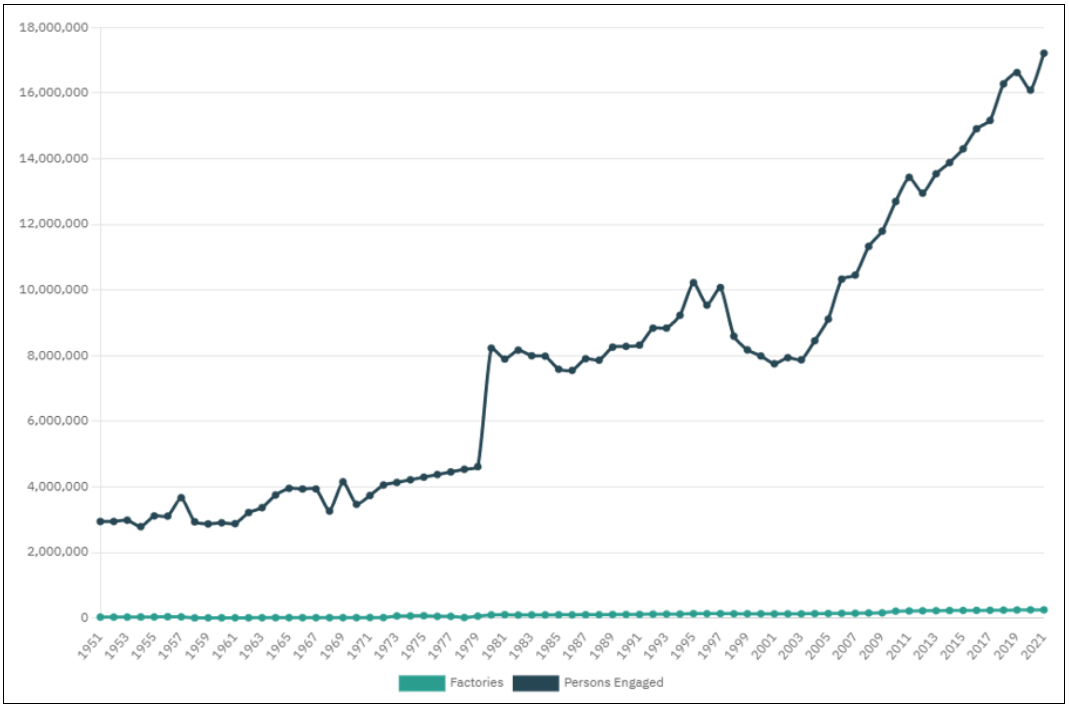
Abstract
The study compares the printing industry of India with its manufacturing sector for their performance during the period from 1951-52 to 2021-22 using time series data. It considers the number of factories, number of persons engaged and the invested capital in achieving their total output. In this process, the study uses multiple regression equations and associated tools. The manufacturing sector and the printing industry have grown during the period of study and the variables considered have different influences on their growth. This study shows that the variables considered have different impact on the entities of the study.

Keywords: Printing, Manufacturing, Capital Invested, Persons Engaged, Total Output, Number of Factories

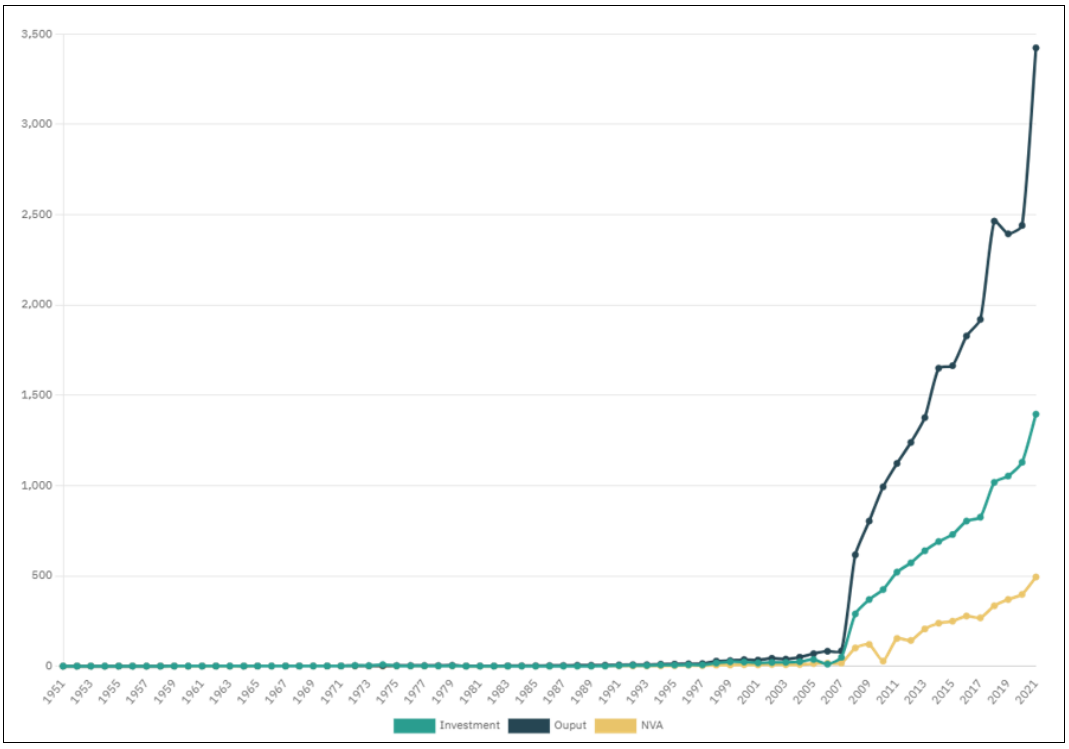
Introduction
The GDP of India has been estimated to grow by 8.2 percent in the Financial Year 2023-24 with a Gross Value Added by 7.2 percent. The manufacturing industry contributed 15 percent of the Gross Value Added amounting to INR 2751.860 billion [1]. The manufacturing sector in India has an investment of about INR 55449 billion in 249987 factories, employing 17215350 persons is contributing an output of about INR 25610 billion with a net value addition of INR 17483 billion in the Financial Year 2021-22. The printing industry which is part of the manufacturing industry has accounted for an investment of about INR 1395 billion with 12475 factories employing 664944 persons and contributing an output of about INR 3423 billion with a net value addition of INR 493 billion. The Net Value Addition of printing industry to manufacturing industry is about is 2.83 percent in 2021-22 and by empoying 3.86 percent manpower [2]. These figures were 2.66 percent for the Net Value Added and 2.54 percent for persons employed in the year 1951-52. The contribution of the printing industry in the manufacturing sector has averaged at 5 percent of the total factories engaging 2 percent of the workforce with an investment of about 1 percent and an output of 2 percent and 0.00034 percent of Net Value Added between 1951-52 to 2021-22 [3]. This paper studies and compares the contribution of the printing industry in India with the manufacturing industry since the time of its Independence and commencement of its collection relevant.

Analysis of Manufacturing Sector and Printing Industry
The manufacturing sector plays a vital role in industrialisation and providing the population with the required manufactured goods for their day to day in making their lives comfortable and technologically adept. In 1951-52 India had 7928 factories employing 2.7 million persons with an investment of INR 7.6873 billion producing an output of INR 453.27 billion adding a net value of INR 6.1294 billion. The growth of the manufacturing industry has been plotted in the two graphs given below. The growth had improved since liberalisation in 1990-91 and since 2008-09 it has accelerated to a great extent.



Source: The National Sample Survey 1950 to 1960 and Annual Survey of Industries1960 to 2021

Fig 1: Number of Manufacturing Factories and Persons Engaged

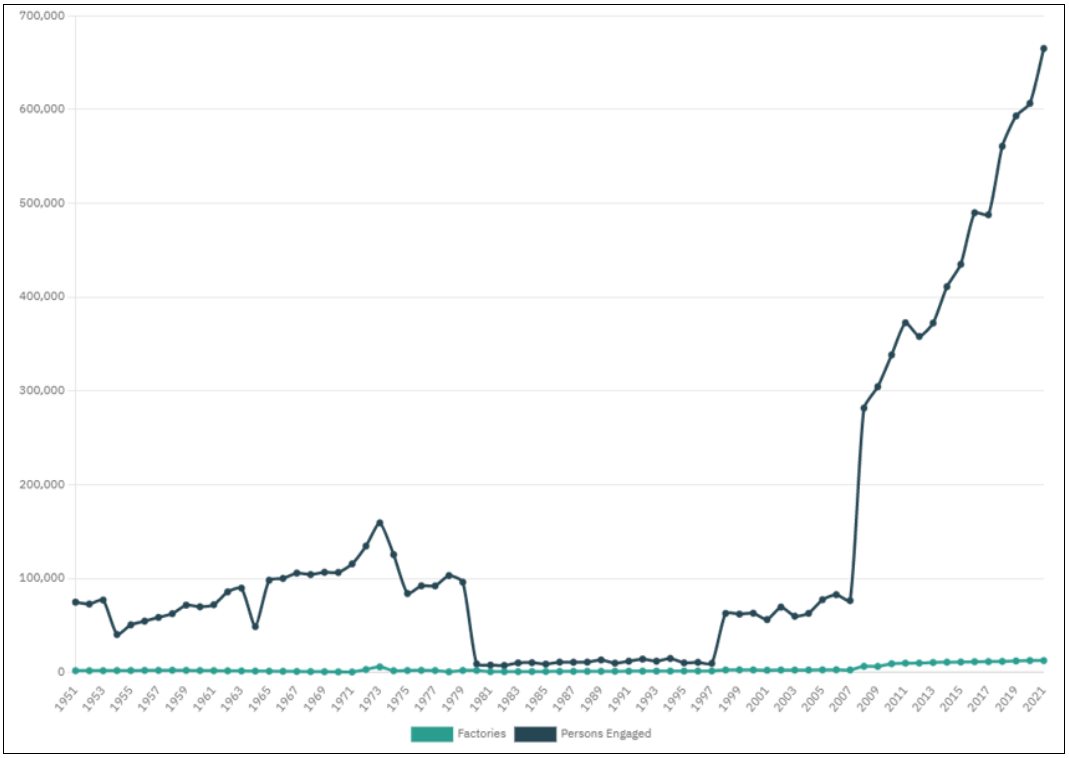


Source: The National Sample Survey 1950 to 1960 and Annual Survey of Industries1960 to 2021

Fig 2: Manufacturing Investments, Output and Net Value Added

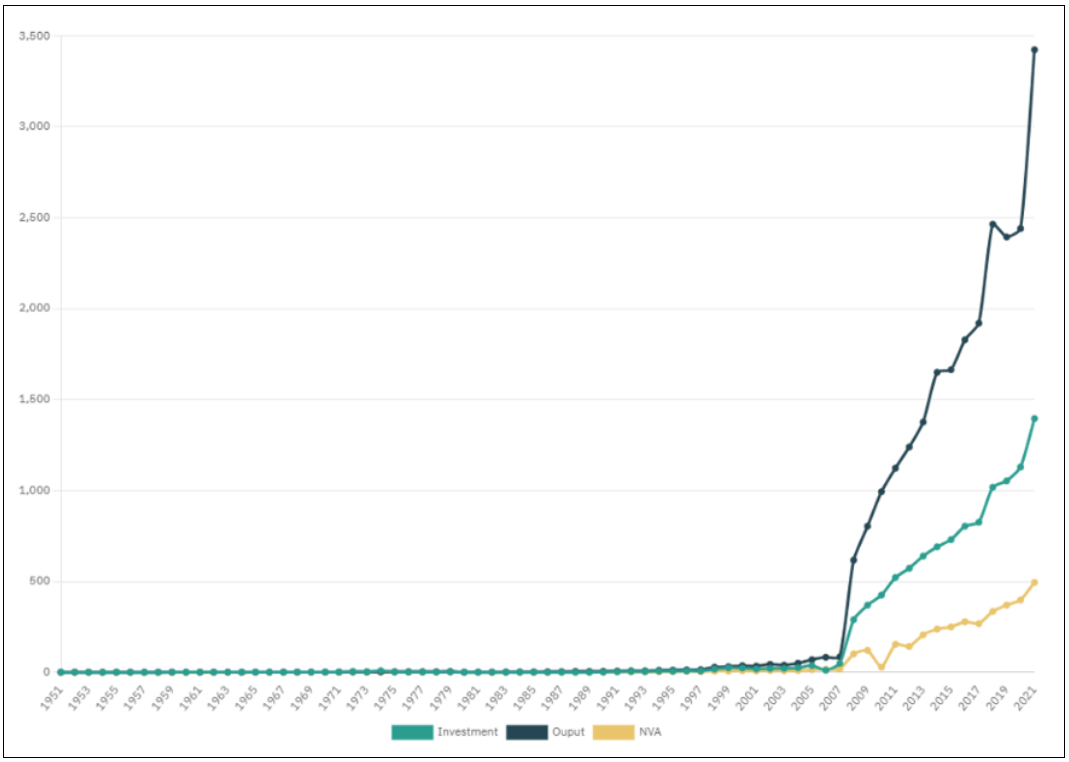
As can be seen in Fig 1 the number of persons engaged in the manufacturing industry has grown steadily since 1980s and since liberalisation in 2000 its employment potential has shown an accentuated growth. The effect of liberalisation on investments is visible from 2003 onwards on output and net value added and has made an impactful growth from 2008. These have a direct bearing on the growth of employment [4].

The printing industry is no exception to this trend and has grown from had 1692 factories employing 0.0747 million persons with an investment of INR 0.1869 billion producing an output of INR 0.1515 billion adding a net value of INR 0.1628 billion. The growth of the printing industry has been plotted in the two graphs given below.



Source: The National Sample Survey 1950 to 1960 and Annual Survey of Industries1960 to 2021

Fig 3: Number of Printing Factories and Persons Engaged



Source: The National Sample Survey 1950 to 1960 and Annual Survey of Industries1960 to 2021

Fig 4: Output of Printing Industry, Output and Net Value Added

The printing industry was among the major contributors to the output and Net Value Addition in the manufacturing sector. The growth had improved since liberalisation in 1990-91 and since 2008-09 it has accelerated. Its net value addition to manufacturing has ranged from the low of 0.12 to 3.04 percent and its average contribution in the same period of study is 1.86 percent. The Figures 3 and 4 show an increasing trend in employment since 1998 and in investment from 2006 and in output and net value added from 2008. As the printing is a service industry and hence its growth is directly related to other production and manufacturing output and growth. It has taken off once the other industries started benefiting from the liberalisation of economy since 1990s.

Review of Literature

Economic Growth is measured by the sustained increase in real, national or per capita income of a nation over time. Economic growth is usually measured in terms of an increase in real GDP over time or an increase in income per head over time. At any time, the economy has some amounts of capital, labour and knowledge and these are combined to produce output. The amount of output obtained from given quantities of capital and labour rises over time, there is technological progress and only if the amount of knowledge increases [5].

The Manufacturing sector covers the Manufacturing Process and has been defined [vide section 2(k)] in the Factories Act, 1948 as: "Any process for- (i) making, altering, ornamenting, finishing, packing, oiling, washing, cleaning, breaking up, demolishing or otherwise treating or adapting any article or substance with a view to its use, sale, transport, delivery or disposal or (ii) pumping oil, water or sewage or (iii) generating, transforming or transmitting power or (iv) composing types for printing by letter press, lithography, photogravure or other similar process or book binding or (v) constructing, reconstructing, repairing, refitting, finishing or breaking up ships or vessels and (vi) preserving or storing any article in cold storage [6]."

The printing industry is a part of the manufacturing sector of the Indian economy. It is classified by the National Industrial Classification (NIC) for all economic activities Division, Group and Sub-classes. The same has been revised a few times and the study is based on the NIC Industrial Classifications of 1970, 1987, 1998, 2004 and 2008 for the printing industry [2].

Total Persons Engaged relates to all persons engaged by the factory whether for wages or not, in work connected directly or indirectly with the manufacturing process and includes all administrative, technical and clerical staff as also labour in production of capital assets for factory's own use. This is inclusive of persons holding position of supervision or management or engaged in administrative office, store-keeping section and welfare section, watch and ward staff, sales department as also those engaged in the purchase of raw materials etc. and production of fixed assets for the factory. It also includes all working proprietors and their family members who are actively engaged in the work of the factory [7].

Investment is the invested capital which is the total of fixed capital and physical working capital [8]. Gross output is defined to include the ex-factory value of products and byproducts manufactured during the accounting year and the net value of the semi-finished goods, value of own construction and also the receipts for industrial and non-industrial services rendered to others, rent received for building, plant and machinery and other fixed assets, net balance of goods sold in the same condition as purchased, value of electricity generated and sold and an amount equal to expenses on research and development. Value of gross output and total output has been used in the text interchangeably to mean the same thing [9].

The gross output and value-added based measures are useful complements in measuring multifactor productivity (MFP). When technical progress affects all factors of production proportionally, the former is a better measure of technical change [10]. The general conclusion of the literature is to favour the gross output approach to MFP measurement. It seems clear that the literature on industry productivity measurement unambiguously favors the use of gross output, or a closely related concept, for multifactor productivity measurement [11].

Research Methodology

This paper uses descriptive approach of research by using quantitative analysis tools to evaluate the relationships and differences of the printing industry and manufacturing sector and their impact on the economic growth of the country. The numerical data processing is carried out using mathematical formulae in this approach. The analysis of data and their results provide a comparison of the manufacturing sector with its constituent, the printing industry in India.

The independent variables considered in this study are number of factories, total persons engaged and invested capital. The dependent variable to determine the economic growth is the value of output. The data is sourced from the National Sample Survey for the years from 1951-52 to 1959-60 and from 1960-61 to 2021-22 Annual Survey of India published by the Government of India. For the year 1972-73, the data has been calculated as no direct data was available. The study uses the multiple regression analysis to estimate the normality, autocorrelation, multicollinearity and heteroscedasticity to the relationships of the manufacturing sector of India with the printing industry of India. Multiple linear regression uses the number of factories, total persons engaged and invested capital to establish the relationship and differences with the output of the manufacturing sector and printing industry. The analysis uses independent sample T-test to see the differences between the independent variables on the total output.

Results

Normality Test

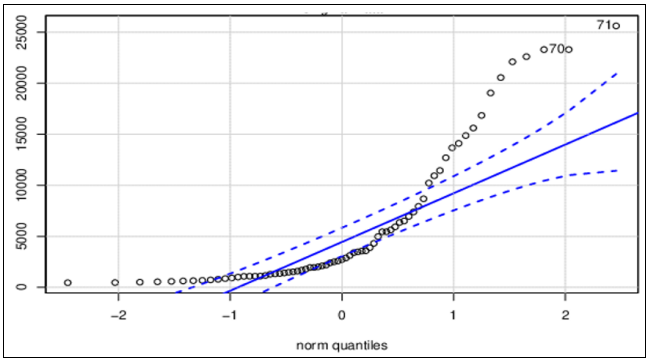


Fig 5: Box-Cox Normality Plot for Manufacturing Sector of India [10]

The data of total output of manufacturing sector is tested for normality with 71 data points, under the assumption of normality, the approximate probability of seeing a normal probability plot correlation as small or smaller than r = 0.8749, which is approximately 0. This is to say that at the α = 0.05 level of significance and there is significant evidence against normality.

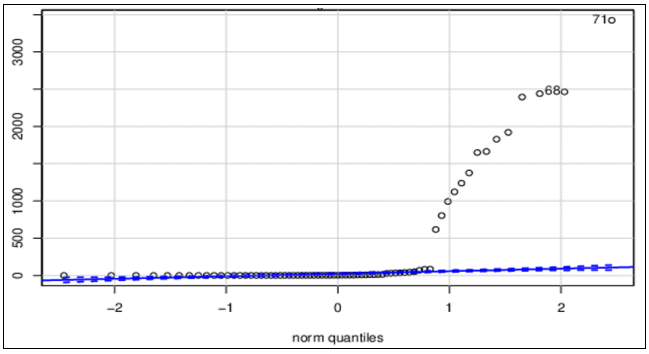


Fig 6: Box-Cox Normality Plot for Printing Industry in India [10]

The data of total output of printing industry is tested for normality with 71 data points, under the assumption of normality, the approximate probability of seeing a normal probability plot correlation as small or smaller than r = 0.7244, which is approximately 0. This is to say that at the α = 0.05 level of significance, there is significant evidence against normality**.**

Autocorrelation Test

	Durbin Watson
Manufacturing Sector	0.852
Printing Industry	0.932

The Durbin-Watson for the manufacturing sector is 0.852 and for the printing industry it is 0.932. Based on the Durbin Watson table 5-dL=1.19868 and 5-dU=1.73584 applies for manufacturing sector and the printing industry. The value of manufacturing sector D = 0.852 and the printing industry D = 0.932, which is less than dL = 1.19868, indicating the existence of a positive correlation.

Multicollinearity Test

Variable	Manufacturing		Printing	
	VIF	Requirement	VIF	Requirement
Number of Factories (F)	27.82874	<10	14.01658	<10
Total Persons Engaged (PE)	32.74027	<10	23.04573	<10
Invested Capital (IC)	5.35714	<10	18.48747	<10

To assess multicollinearity, Variance Inflation Factors (VIF) were calculated for each independent variable in the regression model. As shown in the above Table, the VIF values of manufacturing sector for number of factories it is 27.8287, total persons engaged is 32.74027 and invested capital is 5.35714, which are all above 5, with tolerance of 12.4963 indicating significant multicollinearity issues among these variables. The VIF values for printing industry for number of factories it is 14.01658, total persons engaged is 23.04573 and invested capital I 18.48747, which are all above 5, indicating significant multicollinearity issues among these variables especially for the number of factories and the persons engaged. For the manufacturing sector the VIF for invested capital is less than 10, which is not a symptom of multicollinearity.

Heteroscedasticity Test

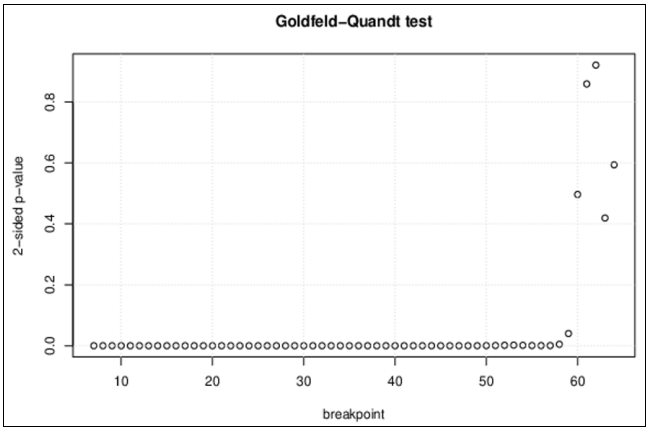


Fig 7: Goldfeld-Quandt Test for Manufacturing Sector in India [10]

The calculated value of for manufacturing sector is 0.9464, which is greater than 0.05 and hence the model used is free from heteroscedasticity.

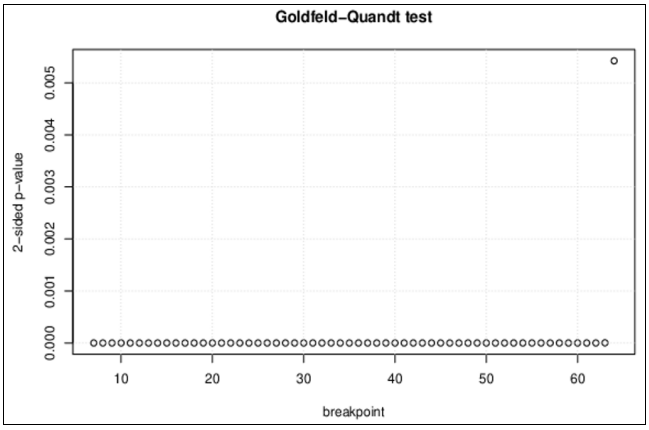


Fig 8: Goldfeld-Quandt Test for Printing Industry in India [10]

The calculated value of for printing industry is 0.9973, which is greater than 0.05 and hence the model used is free from heteroscedasticity.

Independent Sample T-Test

Variable	Coefficients	T-test for Equality of Mean – Two tailed
Number of Factories (F)	Equal variances assumed	10.91513
Total Persons Engaged (PE)	Equal variances assumed	15.37547
Invested Capital (IC)	Equal variances assumed	4.87223

From the above table it can be concluded that there is a significant difference between the entities studied. In the two-tailed test if the significance value is <0.05 there is significant difference and if it is >0.05, then there is no significant difference. The data is homogenous and assumed for equal variances. The values are >0.05and it can be concluded that the values for number of factories, total persons engaged and the invested capital are not significant.

Multiple Linear Regression Analysis Test
Manufacturing Sector

Table 1: Multiple Linear Regression Analysis Test Results for Manufacturing Sector of India [10]

Variable	Coefficients	Estimate	S.D.	T-Stat
Value of Output (OP)				
Intercept	β0	-42.75	284.9	-0.1501
Number of Factories (F)	β1	-0.003239	0.005159	-0.6277
Total Persons Engaged (PE)	β2	-0.0001152	0.0001032	-1.1160
Invested Capital (IC)	β3	+0.3697	0.01129	3.2740

The resultant multiple linear regression test has yielded the multiple linear equation on manufacturing sector of India is given below.

Value of Output = -42.75 -0.003239 (F) -0.0001152 (PE) +0.3697 (IC)

The following are interpreted on the basis of test results and the above equation:

1. Constant = -42.75 shows that when the number of factories (F), the total number of persons engaged (PE) and the invested capital (IC) remain constant, the output of the manufacturing sector will come down by INR 42.75 billion.
2. Regression Coefficient of Number of Factories (F) = -0.003239 indicates a negative correlation that an increase in the number of factories does not result in crease in total output.
3. Regression Coefficient of Total Persons Engaged (PE) = -0.0001152 has a negative correlation, indicating that if the person engaged increases by 1 person, the total output reduces by INR 0. -0.0001152 billion.
4. Regression Coefficient of Invested Capital (IC) = 0. 3697 has a positive correlation, indicating that if the invested capital increases by 1 billion, the total output increases by INR 0.3697billion.

Printing Industry

Table 2: Multiple Linear Regression Analysis Test Results for Printing Industry of India [10]

Variable	Coefficients	Estimate	S.D.	T-Stat
Value of Output (OP)				
Intercept	β0	+20.96	9.553	2.1940
Number of Factories (F)	β1	-0.01339	0.004739	-2.8260
Total Persons Engaged (PE)	β2	+0.00005101	0.00001328	-0.3841
Invested Capital (IC)	β3	+2.484	0.06113	4.0640

The resultant multiple linear regression test has yielded the multiple linear equation on manufacturing sector of India is given below.

Value of Output = 20.96 -0.01339 (F) +0.00005101 (PE) +2.484 (IC)

The following are interpreted on the basis of test results and the above equation:

1. Constant = 20.96 shows that when the number of printing factories (F), the total number of persons engaged (PE) and the invested capital (IC) remain constant, the output of the manufacturing sector will grow by INR 20.96 billion.
2. Regression Coefficient of Number of Factories (F) = -0.01339 indicates a negative correlation that an increase in the number of factories does not result in crease in total output.
3. Regression Coefficient of Total Persons Engaged (PE) = 0.00005101 has a positive correlation, indicating that if the person engaged increases by 1 person, the total output increases by INR 0.00005101 billion.
4. Regression Coefficient of Invested Capital (IC) = 2.484 has a positive correlation, indicating that if the invested capital increases by 1 billion, the total output increases by INR 2.484 billion.

Coefficient of Determination

Table 3: Coefficient of Determination for the Manufacturing Sector and Printing Industry of India [10]

	R	R-Squared
Manufacturing Sector	0.9961	0.9922
Printing Industry	0.9975	0.9950

The R value of manufacturing sector is 0.9677 and the printing industry is 0.9975 which is positive. In general, the model proposes a strong relationship between the variables considered. The values also explain that the linear relationship of variables to output is stronger in the case of printing industry than manufacturing sector. The R-squared value of the manufacturing sector at 0.9961 means that the 99.61% of the independent variables can explain the dependent variable but the remaining 0.39% is explained by the other variables, which are not considered in the study. In the printing industry, 99.50% of the dependent variable is explained by the variables considered in this study and the remaining variables are almost negligible in proportion.

F-Test

Table 4: F-Test for the Manufacturing Sector and Printing Industry of India [10]

	Result	Requirement	p-value
Manufacturing Sector	2109	<0.05	0
Printing Industry	8849	<0.05	0

A multiple regression was run to predict total output from number of factories, persons engaged and investment for both manufacturing sector and printing industry in India. In the case of manufacturing sector this resulted in a significant model with $F(4, 66) = 2109$, $p < 0$, $R2 = .9922$. The individual predictors were examined further and indicated that factories ($t = -6.277$, $p < .5323$) and persons engaged ($t = -1.116$, $p < .2686$) are negative and not significant predictors but, investment not ($t = 3.274$, $p = 1.575 \times 10^{-42}$) is positive and is a significant predictor.

With regard to the printing industry significant model with $F(3, 67) = 8849$, $p < 0$, $R2 = .9987$. The individual predictors were examined further and indicated that factories ($t = -2.826$, $p < .0062$) and persons engaged ($t = -.3841$, $p < .7021$) are negative and not significant predictors but, investment not ($t = 4.064$, $p = 6.177 \times 10^{-49}$) is positive and is a significant predictor. In both the instances the invested capital is positive and is a significant predictor.

T-Test

Table 5: T-Test for the Manufacturing Sector and Printing Industry of India [10]

Variable	Manufacturing			Printing		
	Result	Requirement		Result	Requirement	
Intercept	-0.1501			2.1940		
Number of Factories (F)	-0.6277	>0.05	Influential	-2.8260	>0.05	Influential
Total Persons Engaged (PE)	-1.1160	>0.05	Influential	-0.3841	>0.05	Influential
Invested Capital (IC)	3.2474	>0.05	No effect	4.0640	>0.05	No effect

The t-values of manufacturing sector the intercept is -42.75, which is negative. The t-values of printing industry the intercept is 2.1940 which positive and influences the total output. The variable, number of factories has a significance of -0.6277<0.05, which has a significant influence on the manufacturing sector's total output. In the case of printing industry, the number of factories has a significance value of -2.8260<0.05, therefore the variable, number of factories in printing industries has a significant effect on total output.

The variable, total persons engaged has a significance of -1.1160<0.05, which has a significant influence on the manufacturing sector's total output. For the printing industry the significance of total persons engaged is -0.3841<0.05, so the variable, number of persons engaged in printing industries has a significant effect on total output.

The variable, invested capital of manufacturing sector is 3.2472>0.05, so the variable, invested capital does not have a significant effect on the total output of the sector. The variable, invested capital for the printing is 4.0640>0.05, which does not significantly affect the total output of the industry.

Discussion

The number factories in the manufacturing sector and printing industry have an important role in the total output. The manufacturing industry and its constituent - the printing industry in India have a bearing on the GDP of India. The factories of the manufacturing sector and the printing industry are located across the country and many instances forming clusters and concentrations.

The total number of number of factories in the manufacturing sector has increased by 11.55 percent from 1951-52 to 2021-22. The number of factories makes a negative correlation on the value of output and has a negative impact on the total output of the sector. Although the total output of the manufacturing sector is high in value, the increase in number of factories does not result in proportionately higher total output. In 2021-22 printing industry accounts for 4.99 percent of the factories in the manufacturing sector, which was 5.86 percent at 1951-52, which is the start of the study period. It is observed that the increase in the number of factories in the printing industry has a positive influence on the total output of the industry than the manufacturing sector. When compared with manufacturing sector, the number of factories has grown at higher rate in the printing industry from 1951-52 to 2021-22.

The persons engaged in the manufacturing sector have risen by 17.09 percent during the period of study. However, it has a negative correlation with the total out of the sector and makes a negative impact on the output. This can be due to the efficiency of the persons engaged or the sector is at nascent stage of productivity. The number of persons engaged in the printing industry has risen from 2.54 percent in 1951-52 to 3.86 percent in 2021-22. It has a positive coefficient and it makes a difference in the industry's output. The output of the printing industry is positively related to the total output. The manufacturing sector's performance is significantly higher than the printing industry in the engagement of persons during the study period.

With regard to invested capital in manufacturing sector, the coefficient is positive and makes a positive impact on the total output, though it may not be significant. This can be due to efficiency of the technology invested and its resultant productivity. The coefficient for the printing industry is 2.484 which positive and has a significant impact of its total output. In the printing industry the invested capital was 2.41 percent in 1951-52 and 2.51 percent in 2021-22 of the invested capital in the manufacturing sector. This means that the invested capital is yielding higher total output than the manufacturing sector. This can be attributed to skill of the persons engaged and the use of improved technology. With regard to invested capital both the manufacturing sector and the printing industry perform similarly.

On the basis of the tests carried out, it can be seen that variable number of factories and persons engaged do not have a significant effect on the total output of the manufacturing sector. Also, the investments made in the manufacturing sector are in the past decade and they may yield in increased total output in the coming years. The manufacturing industry is in the process of expansion by way of investment and engaging more persons in the last decade and it may result in increase in skill of the persons engaged and total output. The investment variable in the manufacturing sector is the key for increase in total output as it will result in increase in total output in the long run. The rate of increase in manufacturing sector's output is higher than that of the printing industry. The total output of the printing industry has risen from 0.03 percent in 1951-52 to 13.36 percent in 2021-22 of the output of manufacturing sector.

Conclusions

This study on the comparison performance of the manufacturing sector of India with its constituent printing industry reveals that there is a difference in growth in the number of factories but with similar proportion in the increase in investments. There is a higher increase in the persons engaged in the manufacturing sector with growth of total output though not in proportion. The increase in invested capital has resulted in higher increase in total output in the printing industry.

Limitations of the Study

This paper compares the performance of the manufacturing sector with that of the printing industry, which is one of its constituent. The data for the manufacturing industry is based on the data from its constituent industries and comparing it with its constituent requires generalisations, as the nature, kind and scope of which industry is different. The printing industry consists of different segments and various

classifications. The period of study is long, with considerable changes and improvements in technology and the market in both the entities under studied.

Scope for Further Study

A wholesome and comprehensive research may be carried out on the printing industry in India on its production variables.

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