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ANALYTICAL APPROCH ON ANNUAL SURVEY OF INDUSTRIAL DATA OF NCT OF DELHI DURING THE YEAR 2008-09 to 2011-12

Statistics

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ABSTRACT

In this paper we give the idea for operations of Annual survey of Industrial data for Delhi, NCR for the year 2008-09 to 2011-12 with complete analysis. The Implementation of Industrial Statistical concept like Process Control, Six Sigma, estimation and forecasting, elasticity, correlation and regression analysis and other quantitative quality programs, courses and general statistical methods is the big challenges for industry sector with usual utilization. The new initiative of this work is to analysis the relationship between correlation coefficient and elasticity of major industrial characteristics with estimation the trend and forecasted for future. The considered major characteristics are input capacity and output of industry along with net income and total cost. Emphasis has been given on utilization of industrial statistics concept for industry so that optimum production occurred with best utilization of raw material in limited cost. This paper also established the statistical relationships of interactions in the labour market between employers and the intervention in these relations by governments/government agencies or others.

KEYWORDS:

Annual industrial Survey, Industrial Statistics, Elasticity, Correlation & Regression, Optimisation & quality control. Capital structure, Mandays worked, emoluments, Input, Output and Depreciation, Value Added , Net Income.

INTRODUCTION

Delhi is also known as National Capital Region along with parts of neighboring states Uttar Pradesh and Haryana and Rajasthan. Most importantly, it is the capital of India, has been the hub of trade and activities, and stands tall as the largest commercial centre in the northern half of the country especially in the manufacturing and related activities. It has recorded the highest Per Capita Income in 2013 in India and its secondary sector boasts of a 25% contribution in the State Gross Domestic Product. Thus, it is only natural to assume the importance of the industrial sector's role in the state's economic dynamism. In certain situations, inspection is inevitable, despite the generally held convictions that inspection to improve quality is equivalent to planning for defects and that one cannot inspect quality into a product. Our work is one of the first research works on ASI for relative analysis of statistical and economical concept for operating the sensitivity analysis of industrial production as per demand and supply on net input and output. We have tried to incorporate the thrice concept of statistical economics i.e. coefficient of correlation, coefficient of variation and coefficient of elasticity for the key characteristics of industries.

An attempt is made in this work to utilise the vast sea of facts and figures as presented in the ASI reports and compile the data for a period of four years from 2008-09 to 2011-12. One part of this work throws light on the dependency between various key characteristics, thereby illuminating results and relationships between variables like employment and output or wages and employment etc. Establishing such relations with the help of elasticity and correlation coefficients have cemented certain initial assumptions like a significantly positive relation between **output** and **wages**, and have also helped in the divulgence of critical information like the **employment elasticity of output** for the four year period.

The second part of the analysis deals with forecasting values for two subsequent years, 2012-13 and 2013-14. Data for the past four years has been used and a simple linear regression analysis is executed to facilitate the forecasts. In order to calculate the forecasts, a trend line is fitted in the actual data and the deviations thus observed are calculated. This process can be equated to calculating deviations from an ideal value of say, total output for the four years, and setting a target based on these ideal values for the next two years.

Characteristics of Delhi

Delhi is located in northern India between the latitudes of 28°-24'-17" and 28°-53'-00" North and longitudes of 76°-50'-24" and 77°-20'-37" East. Delhi has an area of 1,483 sq. kms. Its maximum length is 51.90 kms and greatest widthis 48.48 kms. Delhi is situated on the right bank of the river Yamuna at the periphery of the Gangetic plains. It lies a little north of 28 n latitude and a little to the west of 78 longitude. To the west and south-west is the great Indian Thar desert of Rajasthan state, formerly known as Rajputana and, to the east lies the riverYamuna across which has spread the greater Delhi of today. The ridges of the Aravelli range extend right into Delhi proper, towards the western side of the city, and this has given an undulating character to some parts of Delhi. The meandering course of the river Yamuna meets the ridge of Wazirabad to the north; while to the south, the ridge branches off from Mehrauli. The main city is situated on the west bank of the river. Therefore, Delhi is able to providing good environments and market for industrial development and global market in the era of globalization.

INDUSTRIAL STATISTICS OF DELHI

The Collection of Statistics Act, 2008 and the rules framed there under in 2011, prescribe annual collection of statistical information and enjoin the owners of factories/industrial concerns to submit a return enclosed to the notice served by the Directorate of Economics and Statistics, GNCT of Delhi. A separate return for each registered factory/industrial concern should be furnished as a rule. Information furnished in all blocks of the return should relate to the accounting year of the factory closing on any day between 1stApril, 2011 and 31stMarch, 2012. Such collection of statistical information is designated as 'Annual Survey of Industries' (ASI).

The Annual Survey of Industries has so far been conducted annually under the statutory provisions of the collection of Statistical Act, 1953 and the rules framed there under in 1959. However, from ASI 2010-11 onwards, the survey is to be conducted annually under the statutory provisions of the Collection of Statistics (COS) Act, 2008 and rules framed there-under in 2011. The work of collection of Industrial Statistics from the organised industrial sector (Factory –Sector) is entrusted to CSO-IS wing, Government of India. Provision is made for the supply of unit level data of ASI by the CSO (IS Wing), Kolkata to the Directorate of Economics & Statistics for use by the State Government.

The ASI is the principal source of industrial statistics in Delhi. It provides statistical information to assess and evaluate objectively and realistically the change in the growth, composition and structure of the organised manufacturing (Factory Sector) comprising activities associated with manufacturing processes, repair services, personal services, sanitary services, generation and transmission of electricity, gas, water supply and cold storages. Industrial sector occupies an important position in Delhi's economy and plays a pivotal role in the rapid and planned economic development.

The Annual Survey of Industries provides data on various vital aspects of the registered factory/industrial sector. Its main objectives are: a) Estimation of the contribution of manufacturing industries as a whole and of each unit to national income; b) Systematic study of the structure of industry as a whole and of each type of industry and each unit; c) Casual analysis of the various factors influencing industries in the country; d) Provision of comprehensive factual and systematic basis for formulation of policy.

OBJECTIVE OF PAPER

A relation is established between Coefficient of elasticity and Coefficient of correlation for key industrial characteristics. This facilitates to establish a trend for key industrial characteristics using linear regression analysis method for the year 2008-09, 2009-10, 2010-11 and 2011-20012 and forecasting for the year 2012-13 and 2013-2014.

SOURCE OF DATA

Data is collected in the form of secondary source from the Annual Survey of Industries (ASI), Delhi for the years 2008-09 to 2011-12. The paper included the data of the first four years which is available on the website of the Directorate of Economics and Statistics, GNCT of Delhi.

Until 2008-09, NIC – 2004 was followed to classify economic activities of the factories for the ASI reports. A new series of classification i.e. NIC-2008 was introduced from ASI 2008-09. All the factories in the ASI frame were accordingly classified in their appropriate industry groups on the basis of the value of the principal product manufactured by them. This way a unit gets classified in one and only one industry group even though it might be manufacturing products belonging to different industries. The estimates for different aggregates presented at two or three digit level in this report correspond to the NIC 2008, and thus, the data from only ASI 2008-09 onwards has been included in the report.

The reference period for each of the ASI reports used in this report was the accounting year of the factory, ending on any day between 1st April and 31st March of the respective years.

COLLECTION OF DATA

The Collection of Statistics Act, 2008 and rules framed there under in 2011 prescribes annual collection of statistical information and enjoin the owners of factories/industrial concerns to submit the return enclosed to the notice served by the Statistics Officer. A separate return for each registered factory/industrial concern is furnished as a rule. Information furnished in all blocks of the return relates to the accounting year of the factory closing on any day between 1stApril, and 31stMarch of the year.

TABULATION AND PRESENTATION OF DATA

The reports on Annual Survey of Industries (ASI) of the Govt. of NCT of Delhi, issued by the Directorate of Economics & Statistics, are based on unit level data supplied by the CSO (IS Wing), Kolkata on the basis of returns furnished by the factories registered under Sections 2 m (i) & 2 m (ii) of the Factories Act, 1948. These reports were compiled by me for four successive years, i.e. 2008-09 to 2011-12. In this paper, various statistical tables are used and analyzed from these reports. The graphical presentation of some key features is also included in the paper.

METHODOLOGY USED

Some selective concepts of industrial statistics are applied for operation of ASI data viz. Correlation and Regression Analysis, coefficient of variation, Time Series and Forecasting, Elasticity concept of economics etc. We are aware that correlation coefficient is the degree of measurement of relationship between two characteristics /variables, however the similar way coefficient of elasticity also establish the relationship between percentage changes of one characteristic over other characteristic. Each of the manufacturing industrial unit improves the quality of product with the help of quality control and six sigma limit of normal curve.

Both the measurement of coefficient must lies between **$-1 \leq r \geq +1$ or $1 \geq \rho \leq +1$** where r is coefficient of correlation and ρ is coefficient of elasticity**.** Unit positive and negative values of coefficient of correlation are known as **perfectly positive or negative** correlation coefficient respectively. Similarly, unit positive and negative values of coefficient of elasticity are known as **elastic or inelastic** respectively**.** Subsequently, elasticity is further classified as unit elasticity, greater than or less than unitary elasticity, perfectly elasticity, perfectly inelasticity, etc. However if coefficients are 0, it is understood as **no relationship** or no evidence between two characteristics. These coefficient may also related with the area of the normal curve is unit ($i.e. -1 \leq Z \geq +1$) for quality improvement and distribution of manufactured product by six sigma limit.

Relationship between correlation coefficient and elasticity

There is no formal direct relationship between elasticity and correlation coefficient between two variables/characteristics however both have significantly numerical and applicative relationship between this two concept of economics and statistics. The conjunction of these two concepts is known as coefficient of variation which is frequently used in statistics for measurement of dispersion from the averages. The coefficient of elasticity is the generalization of coefficient of correlation which is reflecting the strong relationship to measuring the sensitivity of two variables/characteristics of industrial statistics. This observation is the one of the most important beauty of this research paper.

The former measures the **intensity** of relationship between two variates, and any value for the correlation between two variables is perfectly compatible with elastic or inelastic responsiveness between the two. Correlation coefficient measures the **dependency** of one variable on another, and elasticity between any two variables is possible to be calculated whether it is strongly correlated or weakly correlated. However, a weekly correlated variable will not be very elastic (responsive) to changes of the second variable, and vice versa. Thus, by logical reasoning, it can be concluded that elasticity and correlation coefficient are directly related.

The concept of coefficient of correlation, coefficient of variation and coefficient of elasticity is useful to relate the characteristics behavior of any key indicator involved in industrial statistics over time series data for four years i.e 2008-09 to 2011-12.

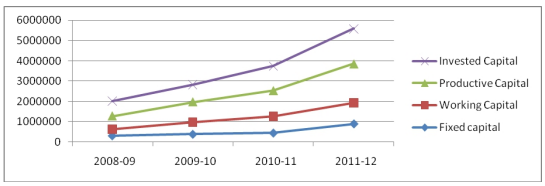
Result and Discussion

The growth estimates is calculated (i.e. percentage changes from one year to the next year) for some principal characteristics (factory sector) is described below. A graphical representation of the same helps to analyze the comparative growth rates better as the slope of the line passing through the points of actual measures gives us an estimate of the growth rate.

Capital Structure, 2008-09 To 2011-12

Characteristics	Unit	2008-09	2009-10	2010-11	2011-12
Fixed capital	Rs. in lakhs	312873	386654	446921	893781
Working Capital	"	328715	604005	821634	1035208
Productive Capital	"	641588	990659	1268555	1928989
Invested Capital	"	740846	861641	1212665	1730193

A growth trend analysis of the given period may be seen in this form. The overall trend of fixed capital is incremental on the given period, the highest percentage increase being around 99.99% from Rs. 446921 lakhs in the year 2010-11 to Rs. 893781 lakhs in the year 2011-12 (due to operational of one big unit). On the other hand, the percentage increase from 2009-10 to 2010-11 was recorded to be the lowest, being 15.58% from Rs. 386654 lakhs to Rs. 446921 lakhs. However, the working capital also shows a similar trend of an increase over the given four years. However, the largest percentage increase in the values was recorded from year 2008-09 to 2009-10, the same being 83.75%. The lowest such increment of 25.26% was observed from Rs. 821634 lakhs in the year 2010-11 to Rs. 1035208 lakhs in the year 2011-12.Much in common to the trends displayed by the working capital, productive capital too shows the highest percentage increase from year 2008-09 by 54.40% to year 2009-10. An increase of 28.05% was recorded as the lowest percentage increase, being from Rs. 990659 lakhs in the year 2009-10 to Rs. 1268555 lakhs in the year 2010-11.

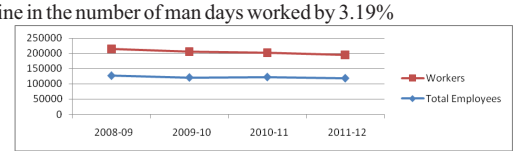


The general trend remains to be that of an increase over the given four The invested capital records a steady increase over the given period of four years. It grew by 42.67% from year 2010-11 to year 2011-12, the same being the highest percentage increase in the given period. The lowest percentage increase was recorded when invested capital grew from Rs. 740856 lakhs by 16.30% to Rs. 861641 lakhs in the years 2008-09 and 2009-10 respectively.

Employment Structure, 2008-09 to 2011-12

Characteristics	Unit	2008-09	2009-10	2010-11	2011-12
Total Employees	Number	126816	121161	122531	118778
Workers	"	87552	84408	79036	76867
Mandays Worked (of Employees)	Number in lakhs	374	363	371	359

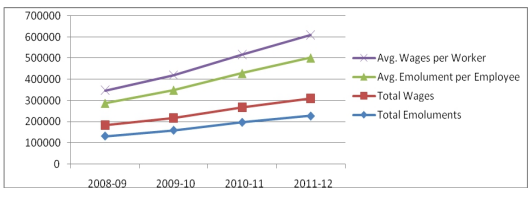
The growth trend analysis of the industrial data for the factory sector is showing the significantly fluctuating for employment structure. The number of total employees in the factory sector first faced a decrease of 4.46%, then an increase of 1.13%, which was then followed by a decrease of 3.06%. Such fluctuation of data clearly marks the year 2008-09 as the year with the highest number of employees, and 2011-12 as the lowest in the four year period. The number of workers shows a consistently downward trend over the four year time frame for which the above data is measured. The highest percentage decrease in the number of workers was seen during the year 2010-11, being 6.36%. The year 2009-10, however, had the lowest percentage decrease in the number of workers, the same being 3.59%. A fluctuating trend was seen in the number of mandays worked by employees, with the trend being that of a decrease of 4.22% in the year 2009-10 followed by an increase of 2.20% in the year 2010-11. 2011-12, however, faced a decline in the number of man days worked by 3.19%



Emoluments and wages, 2008-09 to 2011-12

Characteristics	Unit	2008-09	2009-10	2010-11	2011-12
Total Emoluments	Rs. in lakh	131273	159046	197163	226033
Total Wages	"	52452	58934	70369	81920
Avg. Emolument per Employee	Rs.	103515	131268	160908	191365
Avg. Wages per Worker	Rs.	59910	69822	89034	108312

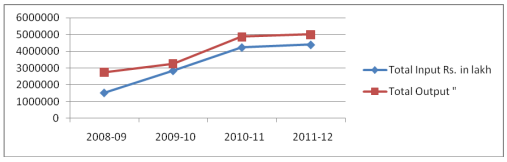
The growth trend analysis of the industrial data for the given four year period is explained in this way. Total Emoluments display a trend of growth during the four year period of study. The highest percentage increase was displayed in the year 2010-11, that of 23.97% from Rs.159046 lakhs to Rs. 197163 lakhs. In 2011-12, there was a percentage increase in the total emoluments by 15.32%, which was the lowest amongst the four years. The total wages in 2010-11 grew by the highest percentage increase of 19.40% from Rs. 58934 lakhs to Rs. 70369 lakhs. In contrast, the lowest such change was observed from Rs. 52452 lakhs in 2008-09 to Rs.58934 lakhs in 2009-10. The general trend in the total wages remained that of an increase over the four year period. The average per employee figure for emoluments shows an increment over the years. It grew by 26.8% from 2008-09 to 2009-10, by 22.57% from 2009-10 to 2010-11 and by 16.41% from 2010-11 to 2011-12. The highest change, thus, was observed between 2009-10 and 2010-11, and the lowest between 2008-09 and 2009-10.The average wages per worker show an increment of 16.54% from 2008-09 to 2009-10, that of 27.51% from 2009-10 to 2010-11 and of 21.65% from 2010-11 to 2011-12. The figures show the highest percentage increase in 2010-11 and the lowest in 2009-10. The overall trend, however, is that of an increment.



Input, Output and Depreciation, 2008-09 to 2011-12

Characteristics	Unit	2008-09	2009-10	2010-11	2011-12
Total Input	Rs. in lakh	1529787	2845553	4235919	4394875
Total Output	"	2747595	3262630	4868702	5089998
Output-Input Ratio		1.16	1.15	1.15	1.14
Output per Worker		31.38	38.65	61.6	65.17
Output-Invested capital Ratio		1.22	3.79	4.01	2.9
Depreciation	Rs. in lakh	34426	41270	44841	50917

The growth trend analysis of the industrial data is flow the increasing trend. Although the figures for total input display an overall growing trend in values, the percentage increases lie on a non-linear path. From 2008-09 to 2009-10, the figures show a percentage increase of 20.32%, followed by a 48.86% increase from 2009-10 to 2010-11, the latter being the highest. The lowest percentage increase was observed from 2010-11 to 2011-12, that of 3.75% only. A trend much similar to the total input was observed in total output. From 2008-09 to 2009-10, the output grew by 18.74%, from 2009-10 to 2010-11, by 49.23% which was the highest, and from 2010-11 to 2011-12, by a mere 4.55% which was the lowest. The figures for depreciation had increased over the four year period. From 2008-09, the figures show an increase of 19.88%, the same being the highest. The percentage increase from 2009-10 to 2010-11 was the lowest, that of 8.65%. 2011-12 saw a change of 13.55% from 2010-11 to 2011-12.The output-input ratio decreased from 2008-09 to 2009-10, remained same over 2009-10 and 2010-11, and then further decreased from 2010-11 to 2011-12. The output per worker shows an increase of 23.16% over the first two years. The highest percentage increase was observed from 2009-10 to 2010-11, that of 59.81%. The lowest such increase was 5.8%, observed from 2010-11 to 2011-12. The overall trend was that of an increase in the figures.The output-invested capital ratio figures show an increase during the first three years from 1.22 to 3.79 and to 4.01 from there. In 2011-12, however, the ratio declined to 2.9.

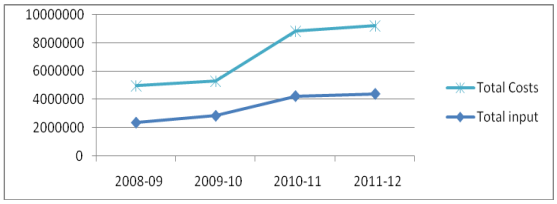


General pattern of cost of production, 2008-09 to 2011-1

The growth trend analysis of industrial data for the given four year period is the trends for the total input, depreciation and employee emoluments have been shown by this manner. Factor payments show an overall increase in value, the highest percentage increase being that of 42.73% from 2009-10 to 2010-11. The lowest percentage increase is that of 10% from 2010-11 to 2011-12.

Characteristics	Unit	2008-09	2009-10	2010-11	2011-12
Total input	Rs. in lakhs	2364993	2845552	4235920	4394875
Depreciation	"	34425	41269	44841	50918
Employee Emoluments	"	125003	159046	197163	226033
Factor Payments	"	73719	82746	118104	129918
Total Costs	"	2598140	2420934	4596028	4803180
T.C. as a% of Total Output	%	94.56	74.2	94.39	95.89

Total costs first decreased by 6.82% over 2008-09 and 2009-10, which was then followed by a significant rise of 89.84% in the next year. This was followed by a mere 4.5% increase in the same in 2011-12 from 2010-11. Total cost as a percentage of total output was calculated and the highest value was observed in the year 2011-12, being 95.89%. As opposed to this, the lowest percentage share of total cost in total output was in 2009-10, being 74.2%.

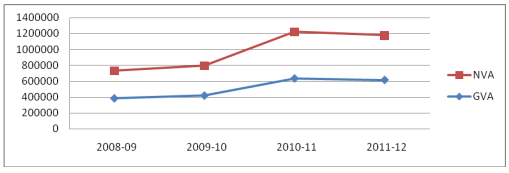


Value added by manufacturing sector, 2008-09 to 2011-12

The GVA grew by 57.72% from 2008-09 to 2009-10, which was the

highest percentage increase during the four year period. In 2010-11, GVA faced a, increase of 56.44%, which was followed by an increased of 9.85% in 2011-12. The NVA showed a similar trend, with 2009-10 having the highest percentage growth of 79.36%, followed by a rise by 56.44% and an increased by 9.59% in years 2010-11 and 2011-12 respectively. The VA-Input ratio and VA-Output ratio have remained approximately constant over the four year period. The VA-Invested capital ratio, however, showed a sudden decline in 2011-12 after an approximately constant trend .

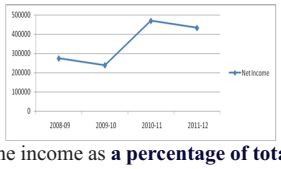
Characteristics	Unit	2008-09	2009-10	2010-11	2011-12
GVA	Rs. in lakhs	382601	417076	632782	695123
NVA	"	348175	375807	587940	644206
VA-Invested Capital Ratio		0.47	0.43	0.48	0.32
VA-Input Ratio		0.15	0.13	0.14	0.13
VA-Output Ratio		0.13	0.12	0.12	0.14

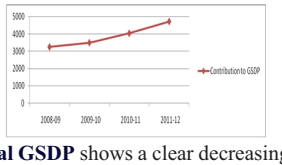


Net income and contribution of registered manufacturing sector to GSDP of Delhi, 2008-09 to 2011-12

Characteristics	Unit	2008-09	2009-10	2010-11	2011-12
Net Income	Rs. in lakhs	274456	293060	469837	514288
Contribution to GSDP	"	324322	348745	402908	470871
% of Total GSDP	%	1.71	1.59	1.54	1.52

Net income, in values, has shown an initial growth, which was followed by a decline in the last year. It grew by 6.78% in 2009-10 from 2008-09, and by 60.32% in 2010-11. It decreased by 7.78% from 2010-11 to 2011-12. The values for contribution to GSDP of the registered manufacturing sector, as taken from the Economic Survey of Delhi 2012-13 give the income in current prices. It shows an overall increasing trend, with the highest percentage increase being 16.8% from 2010-11 to 2011-12. The lowest percentage increase was observed from 2008-09 to 2009-10, that of 7.5%.





The income as **a percentage of total GSDP** shows a clear decreasing trend. Even with an increasing growth trend observed in income's contribution to GSDP, this decreasing trend indicates a growth in total GSDP of Delhi in the given four year period. The elasticity of scale is highest between the years 2009-10 and 2010-11, signifying a 1.007% responsiveness of total output for every 1% change in total input.

Elasticity of Scale – Output Elasticity of Total Inputs

Characteristics	Unit	2008-09	2009-10	2010-11	2011-12
Total Output	Rs. In lakhs	2747595	3262630	4868702	5089998
Total Input	"	1529787	2845553	4235919	4394975

Input/ Output	0.55	0.87	0.87
Elasticity($\rho_{x,y}$)	0.21	1.00	0.76

This unitary elasticity of scale is an indication of constant returns to scale, which in turn implies a 1:1 ratio of the inputs and the returns thus received. A slight variation is observed in the elasticity between years 2010-11 and 2011-12, with the elasticity coefficient decreasing to 0.767. The lowest elasticity of scale is measured between the years 2008-09 and 2009-10, the same being 0.217. Since in these instances, output increases by less than the proportional change in inputs, they display decreasing returns to scale. The average elasticity for the four year period comes out to be 0.66.

Output Elasticity of Total Costs

Characteristics	Units	2008-09	2009-10	2010-11	2011-12
Total Output	Rs. in Lakhs	2747595	3262630	4868702	5089998
Total Costs	"	2598140	2420934	4596028	4803180

Total cost/ Output	0.94	0.74	0.94
Elasticity($\rho_{x,y}$)	-2.74	0.54	0.63

Highest elasticity coefficient is observed between years 2008-09 to 2009-10, the same being (-2.748). This reflects the highest responsiveness in total output to changes in total costs in that year. The negative sign explains the increase in output in response to a decrease in total cost. In the following years, elasticity coefficients show a decline. In year 2009-10 to 2010-11, the output elasticity of total cost was 0.547, while in 2010-11 to 2011-12, it was 0.639. These two years thus witness inelasticity in output with respect to changes in total cost. The average elasticity for the four years is calculated to be 0.52.

Employment Elasticity of Total Output

Characteristics	Units	2008-09	2009-10	2010-11	2011-12
Total Employees	Number	126816	121161	122531	118778
Total Output	Rs. In Lakhs	2747595	3262630	4868702	5089998

Output / Employment	21.66	26.92	39.73
Elasticity(ρ x,y)	-0.23	0.02	-1.06

Highest employment elasticity was seen in the year 2010-11 to 2011-12, where the employment fell by 1.062% for every 1% increase in total output. While employment is elastic in this case, it is important to note that this is the highest percentage fall that employment levels experience with a unit rise in output. In 2008-09 to 2009-10, the employment elasticity coefficient was -0.237, which implies that for every 1% increment in total output, employment levels fell by 0.23%. In contrast, the elasticity coefficient for 2009-10 to 2010-11 was a positive 0.029, which, although signifying a lower level of responsiveness as compared to the other two, signals to a 0.029% increase in employment level for every 1% increase in output. The average elasticity for the four year period comes out to be (-0.42).

Income Elasticity of Total Output

Characteristics	Units	2008-09	2009-10	2010-11	2011-12
Net Income	Rs. in lakhs	274456	239060	469837	514288
Total Output	"	2747595	3262630	4868702	5089998

Output / Income	10.01	13.6	9.89
Elasticity($\rho_{x,y}$)	-0.68	1.96	-2.59

The highest elasticity coefficient was observed in the period between 2010-11 and 2011-12. The elasticity coefficient was calculated to be (-2.598), which implies that for every 1% increase in output levels in that period, net income of production declined by 2.698%. Between the years 2008-09 and 2009-10, the elasticity was (-0.688), thus signifying income inelastic with respect to total output in that period. In 2009-10 to 2010-11, it was observed that income responded more than proportionately to total output levels, thus making it elastic with a coefficient of 1.961. This is also the only year with a positive elasticity coefficient. The average elasticity for the four year period was calculated to be (-0.47).

Output Elasticity of Invested Capital

Characteristics	Units	2008-09	2009-10	2010-11	2011-12
Total Output	Rs. In Lakhs	2747595	3262630	4868702	5089998
Invested Capital	"	740846	861641	1212665	1730193

Capital / Output	0.26	0.26	0.24
Elasticity($\rho_{x,y}$)	1.149	1.20	0.06

The elasticity coefficient between the years 2009-10 to 2010-11 was calculated to be 1.208, which was also the highest value amongst the three. This implies that in that period, output grew by 1.20% for every 1% increase in the level of invested capital. Very close to the highest value, the elasticity coefficient in 2008-09 to 2009-10 was calculated to be 1.149. The only period for which output was inelastic with respect to invested capital was calculated for the year 2010-11 to 2011-12. This signifies the less than proportionate growth in total output levels for increases in invested capital. Capital investment complements a shift towards a higher skilled workforce and research and development (R&D), both of which augment growth. Thus, high positive elasticity coefficients benefit the industrial sector. The average elasticity coefficient for the four year period is 0.8. The correlation coefficient, $r_{x,y}$, is calculated to be(-0.987),which is very close to total negative correlation ($r_{x,y}$=1).

Correlation Coefficient between Wages and Employment

Year		2008-09	2009-10	2010-11	2011-12
Total Wages	x_i	52452	58934	70369	81920
Workers	y_i	87552	84408	79036	76867

Workersyi875528440879036768 67Hence, the observed linear correlation between total wages and workers is measured to be very high. The given significantly negative linear dependence between wages and workers signifies that all data points lie on a line for which total wage decreases as the number of workers increases. Conflicting evidences for employment-wage relationships have been observed by economists all over the world. This coefficient tends to differ from country to country and region to region, hence not establishing a clear and definite dependence relationship between the two variables. It can be argued that time series analysis, along with the problem of less number of observations, is not capable of capturing the direction of wage-employment relationships.

Correlation Coefficient between Employment and Output

Years		2008-09	2009-10	2010-11	2011-12
Total Employees	Xi	126816	121161	122531	118778
Total Output	Yi	2747595	3262630	4868702	5089998

The correlation coefficient (r_{xy}) for the four year period between employment and output is calculated to be (-0.709), which can be interpreted as a high value of linear dependence between the two observed variables. The negative correlation coefficient as a result of negative covariance points towards an inverse relationship between employment and output in the manufacturing sector. As employment levels decline, total output shows an increment in value. This high correlation coefficient complements the low employment elasticity values calculated in the previous section. India on the whole has been plagued by the issue of a jobless growth and this negative correlation coefficient is a proof of the grave problem at hand.

Correlation Coefficient between Wages and Output

Years		2008-09	2009-10	2010-11	2011-12
Total Wages	Xi	52452	58934	70369	81920
Total Output	Yi	2747595	3262630	4868702	5089998

There is a high positive correlation between total wages and total output, as measured by the correlation coefficient rx, y= 0.939. This basically points towards a strong dependency of wages on the value of output, as was expected. Since the correlation coefficient came out to be positive, it is confirmed that as the level of total output increases, total wages face an increment too.

Correlation Coefficient between Input and Output

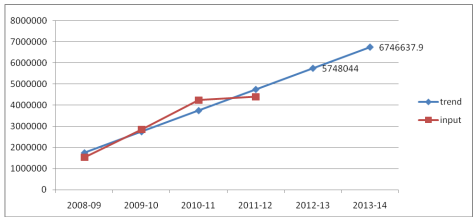
Year(*scaling)		2008-09	2009-10	2010-11	2011-12
Total Input*	xi	1529	2845	4235	4394
Total Output*	Yi	2747	3262	4868	5009

The value of the correlation coefficient is near about unity i.e. 0.974. This signifies a high dependency between inputs and outputs. As was anticipated, the significantly positive correlation coefficient highlights the fact that as value of inputs rise, value of output rises too. It is thus obvious that since input and output levels are almost perfectly related to each other, maximum output has been generated by maximizing the input capacity of the industries. Comparing these results to the elasticity of scale, which on an average is 0.655, we see that high elasticity is observed between the variables which also have a high correlation coefficient.

Estimation and Forecasting: Simple linear regression analysis method has been employed to calculate linear trend line and forecast values for the respective characteristics for the years 2012-13 and 2013-14. The equation of the line is of the form y=a+bx, where 'a' is the intercept value and 'b' is the slope (or rate of change).

TOTAL INPUTS

Year	Input	Trend Values
2008-09	1529787	1753668
2009-10	2845553	2752262
2010-11	4235919	3750856
2011-12	4394875	4749450
Forecasted values		
2012-13		5748044
2013-14		6746638



The highest deviation from trend values is observed in the year 2010-11, where the actual value of total input is higher by Rs. 485063 lakhs. The equation of the regression line was calculated to be y=755074.5+998593.9x. When subsequent figures for x were substituted in the equations, the forecasts for total input according to the linear trend line were Rs. 5748044 lakhs for 2012-13 and Rs. 6746637.9 lakhs for 2013-14.

TOTAL OUTPUT

When the linear trend line was fitted in the actual values, the highest deviation of Rs. 289846.4 lakhs was observed in the year 2009-10. The equation of the regression line was calculated to be y=1874365+839055.7x.

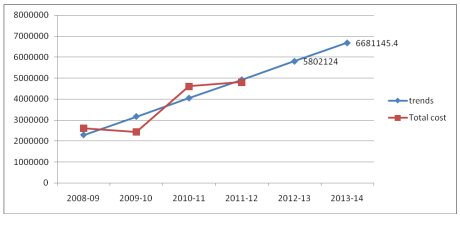
Year	Total Output	Trend Values
2008-09	2747595	2713421
2009-10	3262630	3552476
2010-11	4868702	4391532
2011-12	5089998	5230588
Forecasted values		
2012-13		6069644
2013-14		6908699

When subsequent figures for x were substituted in the equations, the forecasts for total output according to the linear trend line were Rs. 6069644 lakhs for 2012-13 and Rs. 6908699 lakhs for 2013-14.

TOTAL COSTS

The highest deviation from the trend values was observed in the actual total cost values of 2009-10, the same being Rs. 744125.8 lakhs. The equation of the regression line was calculated to be y=1407017 +879021.4x. When subsequent figures for x were substituted in the equations, the

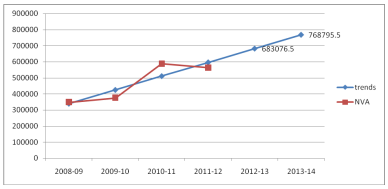
Year	Total Costs	Trend Values
2008-09	2598140	2286038
2009-10	2420934	3165060
2010-11	4596028	4044081
2011-12	4803180	4923103
Forecasted values		
2012-13		5802124
2013-14		6681145



Forecasts for total costs according to the linear trend line were Rs. 5802124 lakhs for 2012-13 and Rs. 6681145 lakhs for 2013-14.

NET VALUE ADDED The highest deviation from the trend values was observed in the year2010-11, where the actual values of Net Value Added exceeded the trend value by Rs. 76301.5 lakhs.

Year	Net Value Added	Trend Values
2008-09	348175	340200
2009-10	375807	425919
2010-11	587940	511638
2011-12	644206	677357
Forecasted values		
2012-13		683076
2013-14		768795



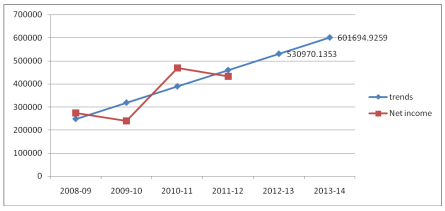
The equation of the regression line was calculated to be y=254481.5+85719x. When subsequent figures for x were substituted in the equations, the forecasts for net value added according to the linear trend line were Rs. 683076.5 lakhs for 2012-13 and Rs. 768795.5 lakhs for 2013-14.

NET INCOME: The highest deviation from the trend values was observed in the year2010-11,where the actual value was higher than the trend value by Rs. 80316.4 lakhs.The equation of the regression line was calculated to be y=177346+70724.7x. When subsequent figures for x were substituted in the 7linear trend line were Rs. 530970.1 lakhs for2012-13 and Rs. 601694.9 lakhs for 2013-14.

Year	Net Income	Trend Values
2008-09	274456	248071
2009-10	239060	318795
2010-11	469837	389520
2011-12	514288	540245
Forecasted values		
2012-13		570970
2013-14		641694

CONCLUSION

Hence, it may be concluded that the elasticity coefficients for the major characteristics of ASI, Delhi lies within the bracket -2.7 to 1.96. It reflects that some of the units are incurring losses or under reporting in any sense whereas some are gaining significantly. It will be better, if elasticity coefficient would exist between the brackets of -1 to +1 for establishment of better comparative analysis relationship between elasticity and correlation. . Thus, it requires further examination of data as well as industrial policy of the Government of Delhi. Highest elasticity is observed in **net income** with respect to **the output** in the year 2010-11, and the lowest was observed in **total output** with respect to **total cost** in the year 2009-10. None of the characteristics is perfectly elastic i.e. unit elastic.



In the similar manner the correlation coefficients lies between -1 and 1 and satisfies all the conditions of degree of correlation coefficient. Highest correlation coefficient is observed between **output and input** and the lowest is observed in **employment and total output**. That means output and input are strongly related to each other. Mathematically, we can say output is fully dependent on input capacity of industry. On the other hand, employment in industry is weakly related to total output which clarifies that ***"Increasing trend fully depends on capacity of Machine instead of workers".*** This ASI data may also be operated by Quality Control and six sigma limit of Normal Distribution in near future for improvement of manufacturing industry.

Elasticity	2009-10	2010-11	2011-12
Output elasticity of total cost	-2.7483	0.5479	0.6398
Employment elasticity of output	-0.2379	0.0230	-1.0622
Income elasticity of output	-0.6880	1.9610	-2.6984
Output elasticity of capital	1.14964	1.2083	0.06757

The elasticity coefficients calculated lie within the bracket -2.7 to 1.96. Highest elasticity is observed in net income with respect to the output in the year 2010-11, and the lowest was observed in total output with respect to total cost in the year2009-10. None of the variables are unit elastic.

Correlation coefficients

Correlation coefficient b/w wages and employment	-0.987
Correlation coefficient b/w employment and output	-0.709
Correlation coefficient b/w wages and output	0.939
Correlation coefficient b/w output and input	0.975

All correlation coefficients lie between -1 and 1 and satisfy the all the conditions of degree of correlation coefficient. Highest correlation coefficient is observed between output and input and the lowest is observed in employment and total output. That means output and input are strongly related to each other. Mathematically we can say output is fully dependent on input capacity of industry. On the other hand, employment in industry is weakly related to total output.

The calculated employment elasticity and correlation coefficient between employment and output was to be very low the in the industrial sector. This point indicating towards **jobless growth** in industry sector and compiles rapidly dependency toward machinery. This is a problem plaguing India and may be needs to be addressed at the earliest. It is also seem that the measures the intensity of relationship b/w two variates and any value for the correlation b/w quantity of input and price paid is perfectly compatible with an elastic or inelastic output.

Forecasting results

Char. of ASI	2012-13	2013-14
Total input	5758044	6746638
Total output	606944	6908699
Total Cost	5802124	6681145
Net Value Added	683076	768795
Net Income	570970	641695

It is most important to verify the forecasted result is near about to actual of Delhi from ASI Report for the period of 2013-13 and 2013-14. If it is matched with the actual figure within the 10% of variation then it is assumed that the forecasted result of this paper is optimum and feasible suggestion for Delhi as being statistical expert.

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