MEASURING PRODUCTIVITY IN IT SECTOR COMPANIES INCLUDED IN NIFTY 50: AN EMPIRICAL STUDY

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ABSTRACT

Productivity is a ratio of monetary value of output to the monetary value of input. Higher the productivity ratio of a company denotes more efficiently the company has used its resources. In the present research, an attempt has been made to measure, analyse and compare productivity of four companies of IT sector during the period from 2010-11 to 2017-18 i.e. for eight years.

Intra-company comparison has been drawn with the help of chi-square test and results indicate that null hypothesis is accepted in all the cases of IT companies. Inter-company comparison has been drawn with the help of Kruskal Wallis One Way ANOVA Test and results indicate that null hypothesis is rejected.

After analysing the average overall productivity it is observed that overall productivity is almost one that means IT sector companies are not optimally utilizing its resources, it is just meeting its cost. It is recommended that the companies should take steps to maintain the productivity ratio high in future by optimally utilizing the resources.

Keywords: Overall Productivity, Investor Input, Average Investment, Kruskal Wallis One Way ANOVA Test.

INTRODUCTION

The idea of productivity has been continuously emerging since early fifties till contemporary times. The key to progress and prosperity lies in the essence of higher productivity leading to enhanced standard of living. The higher productivity has been marked by the curbed wastage, better wages and working conditions, low prices for consumers and higher dividends to shareholders, improved exports and foreign exchange etc. All these elements contribute towards social progress and economic growth, which in result; assist in eliminating the core problems of our country viz., mass poverty and mass unemployment. Hence, productivity serves as an important indication of the growth rate and performance of entire economy in this ever-changing scenario.

With the prevalence of technology over the time, things have become more feasible and easy that its adoption helps in saving time at great extent.

Hence, the concept of productivity has become a matter of great significance nowadays.

This modern era is full of many opportunities that may increase the productivity level. The productivity has now become the necessity, not only for the development of the organisation but also for the survival in this competitive world.

National Research Council (1979) stated, "Productivity is the relationship between output produced and one or more of associated inputs used in the production process."

Productivity of a concern indicates that how much has been produced as output by all the input taken together. It measures effective utilisation of overall input on the basis of limited output.

$$\text{Productivity} = \frac{\text{Total Output}}{\text{Total Input}}$$

LITERATURE REVIEW

Many studies on productivity trends in India and abroad have been carried out over the last few decades. Few studies are being summarised below:

Simpson (2009) in his research paper titled "Productivity in Public Services" explored the issues arising in measurement of productivity in public services. There are many limitations arising in measuring productivity of public services because mainly public services are unpriced and some public services are consumed collectively. These limitations are generally not faced in the private sector.

Jain (2011) in his thesis analysed the cost structure, profitability and productivity of five companies for a period of 5 years from 2004-05 to 2008-09 of pharmaceutical industry in India. The study also examined the scope for improvement in profitability by eradicating reasons responsible for low profit margin and suggested the ways and means by which management can improve the performance of the companies.

Globerson and Vitner (2019) has presented a model which aimed at measuring the productivity of a product or a service that are producing different products. Two methodologies have been adopted for calculating the output taking into consideration the value of item which are in process and assigning the weights to each and every product according to the level of usage of the most frequently used resource.

Research Gap: As per the above reviews and many more studies studied related to the topic, there is no study on overall productivity of IT sector companies included in Nifty 50. So in this present research an attempt has been made to measure the overall productivity of IT sector companies.

OBJECTIVES

1. To measure, analyse and compare the overall productivity for the IT sector companies included in Nifty 50.

2. To compare the intra-company and inter-company overall productivity for the study period.

3. To suggest ways for the improvement in overall productivity.

RESEARCH METHODOLOGY

Collection of Data

This research is based on the secondary data. The data and information regarding output, average investment, overall input and all other financial variables has been obtained from the

annual reports of the respective companies i.e. Infosys Ltd., Tata Consultancy Services Ltd., Tech Mahindra Ltd. and Wipro Ltd. The annual reports are available on the website of these companies and also the data related to index numbers has been collected from various bulletins published by Reserve Bank of India on its website.

Selection of Base Year

The year 2010-11 has been taken as the base year. The revaluation of output and input is done on the basis of this year.

Model to be used

In the present research Productivity Accounting Model propogated by H. S. Davis has been used for measuring overall productivity because it considers all the elements of output and input, ignoring the effect of inflation.

Hypotheses

Intra-Company Hypothesis: Tested with the help of Chi-Square Test.

Null Hypothesis (H0): There is no significant difference in the overall productivity indices of the sampled company for the study period and can be represented by straight line trend or line of best fit.

The acceptance of null hypothesis would reveal that the overall productivity indices of the sampled company for the study period are approximately equal.

Inter-Company Hypothesis: Tested with the help of Kruskal Wallis One Way ANOVA Test.

Null Hypothesis (H0): There is no significant difference in the overall productivity ratios for the sampled companies.

CALCULATION OF INDEX NUMBERS AND CONVERSION FACTORS

For revaluation of data as per the base year's prices index numbers and conversion factors has been used. Here base year is 2010-11. Backward Splicing technique has been used for calculating the index numbers of 2010-11. Following formula has been used to calculate conversion factors:

$$\frac{\text{Index number of the base year}}{\text{Index number for the current year}}$$

Table 1: Index Numbers and Conversion Factors for Revaluation of Data

Year	Wholesale Price Index		Consumer Price Index for Industrial Workers		Fuel and Power Index	
	Base year 2011-12 = 100	Conversion Factors	Base Year 2001 = 100	Conversion Factors	Base Year 2011-12 = 100	Conversion Factors
2010-11	91.80	1.000	180.00	1.000	87.75	1.000
2011-12	100.00	0.918	195.00	0.923	100.00	0.878
2012-13	106.90	0.859	215.00	0.837	107.10	0.819

2013-14	112.50	0.816	236.00	0.763	114.70	0.765
2014-15	113.90	0.806	251.00	0.717	107.70	0.815
2015-16	109.70	0.837	265.00	0.679	86.50	1.014
2016-17	111.60	0.823	276.00	0.652	86.30	1.017
2017-18	114.90	0.799	284.00	0.634	93.30	0.941

REVALUATION OF OUTPUT

The output of the companies has been revalued by multiplying the output values with the conversion based on wholesale price index.

REVALUATION OF OVERALL INPUT

All inputs that is material, labour, overhead and investor input are added together and constituted the overall input. When overall input is compared with the output, it is known as the overall productivity. Different inputs have been revalued with the different index numbers according to the nature of the inputs.

Material Input: Revalued with whole sale price index.
Labour Input: Revalued with consumer price index for industrial workers.
Overhead Input: Power and Fuel- Revalued with fuel and power index.
Repairs & Maintenance and Business Service Input: Revalued with wholesale price index. Depreciation and Amortisation- Not revalued.
Investor Input: Investor input is calculated by multiplying the base year rate of return with the average investment in succeeding years.
Average Investment: Fixed Assets: Taken on historical values as shown in the balance sheet. Non-current investments, long term loans and advances and other non-current assets, current assets, current liabilities, profit- Revalued with wholesale price index. Half of the profit has been deducted from the value of investment to obtain the average investment.
Base Year Rate of Return: The base year rate of return based on industry standard for inter-company comparison has been calculated with the help of the following formula:

$$R_I = \frac{R_1 + R_2 + R_3 + R_4 \text{ (Rate of Return of Sector Companies)}}{AI_1 + AI_2 + AI_3 + AI_4 \text{ (Average Investment of Sector Companies)}} \text{ X } 100 = 38.48\%$$

OVERALL PRODUCTIVITY

Overall productivity of IT sector companies has been shown from table 2 to 5 from 2010-11 to 2017-18 taking 2010-11 as the base year for revaluation.

Table 2: Overall Productivity of Infosys Ltd

Base Year 2010-11 Amount in ₹ crore

S.No.	Items	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
1	Output	26532.00	30814.51	33555.12	38284.27	40813.42	47702.30	51314.87	52702.04
2	Material Input	482.00	595.78	649.40	767.86	820.51	901.45	1041.92	1032.31
3	Labour Input	12459.00	14281.58	16683.08	18579.05	18007.46	19151.87	20175.49	20587.25
4	Overhead Input	4770.00	5443.02	5297.06	6414.54	6721.90	8626.95	9490.58	10124.12
5	Total Input (Company Standard)	17711.00	20320.38	22629.55	25761.44	25549.86	28680.28	30707.98	31743.68
6	Normal Investor Input @ 38.48% (Industry Standard)	8197.97	9036.04	10526.50	11843.11	13183.05	15971.19	19578.73	17454.79
7	Total Input (Industry Standard)	25908.97	29356.42	33156.05	37604.55	38732.91	44651.47	50286.71	49198.47
8	Overall Input Output Ratio (Industry Standard)	0.9765	0.9527	0.9881	0.9822	0.9490	0.9360	0.9800	0.9335
9	Overall Productivity Ratio (Industry Standard)	1.0240	1.0497	1.0120	1.0181	1.0537	1.0683	1.0204	1.0712
10	Overall Productivity Indices (Industry Standard) (O)	100.00	102.50	98.83	99.42	102.90	104.32	99.65	104.61

11	Computed Value / Expected Values (E)	99.95	100.40	100.85	101.30	101.75	102.21	102.66	103.11
12	Chi-Square (O-E)2/E	0.0000	0.0441	0.0406	0.0351	0.0129	0.0439	0.0882	0.0217

Average Overall Productivity Indices=101.53, a=101.53, b=0.23, x^2=0.2864, S.D.=2.17, C.V.=2.14%.

Overall productivity ratio is the lowest 1.0120 in 2012-13 while it is the highest 1.0712 in 2017-18. The highest ratio indicates efficiency and effectiveness while the lowest ratio indicates that the overall input has not been utilized efficiently. The table value of chi-square at 5% level of significance with 8-1=7 d.f. is 14.067 while the calculated value of chi-square is 0.2864. As the calculated value of chi-square is less as compared to the table value hence null hypothesis is accepted. This reveals that the overall productivity indices of Infosys Ltd. for the study period are approximately same and can be represented by straight line trend or line of best fit.

Table 3: Overall Productivity of Tata Consultancy Services Ltd

Base Year 2010-11 Amount in ₹ crore

S.No.	Items	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
1	Output	29771.01	38137.37	43513.96	55314.66	62904.22	74998.91	80044.98	82424.84
2	Material Input	17.75	10.84	21.51	32.47	52.13	33.34	1447.66	1602.00
3	Labour Input	10190.31	13014.68	14297.40	16378.99	19623.09	20416.30	31371.63	32650.37
4	Overhead Input	10840.77	12941.28	15402.10	18709.40	21642.28	25760.43	14520.79	14467.75
5	Total Input (Company Standard)	21048.83	25966.80	29721.01	35120.85	41317.50	46210.07	47340.08	48720.12
6	Normal Investor Input @ 38.48% (Industry Standard)	6197.68	7214.48	9278.16	11971.19	12266.20	16339.72	22020.57	20619.08
7	Total Input (Industry Standard)	27246.51	33181.28	38999.17	47092.04	53583.70	62549.79	69360.65	69339.20

8	Overall Input Output Ratio (Industry Standard)	0.9152	0.8700	0.8962	0.8513	0.8518	0.8340	0.8665	0.8412
9	Overall Productivity Ratio (Industry Standard)	1.0927	1.1494	1.1158	1.1746	1.1739	1.1990	1.1540	1.1887
10	Overall Productivity Indices (Industry Standard) (O)	100.00	105.19	102.12	107.50	107.44	109.74	105.62	108.79
11	Computed Value / Expected Values (E)	102.20	103.22	104.25	105.28	106.31	107.34	108.37	109.40
12	Chi-Square (O-E)2/E	0.0472	0.0374	0.0439	0.0467	0.0119	0.0533	0.0700	0.0034

Average Overall Productivity Indices=105.80, a=105.80, b=0.51, x^2=0.3138, S.D.=3.12, C.V.=2.94%.

Overall productivity ratio is the lowest 1.0927 in 2010-11 while it is the highest 1.1990 in 2015-16. The highest ratio indicates efficiency and effectiveness while the lowest ratio indicates that the overall input has not been utilized efficiently. For testing the hypothesis chi-square method has been used. The table value is 14.067 while the calculated value of chi-square is 0.3138. As the calculated value of chi-square is less as compared to the table value hence null hypothesis is accepted. This reveals that the overall productivity ratios of the company for the eight year period are same and can be represented by straight line trend or line of best fit.

Table 4: Overall Productivity of Tech Mahindra Ltd

Base Year 2010-11 Amount in ₹ crore

S.No.	Items	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
1	Output	5092.10	4875.22	5073.86	13354.17	15545.48	18479.45	19799.98	20288.13
2	Material Input	1.50	0.46	0.00	0.00	0.00	0.00	0.00	0.00

3	Labour Input	1943.80	2077.67	2104.05	5319.25	5163.26	5031.46	5049.35	5139.52
4	Overhead Input	2229.50	2130.54	2138.63	5122.90	7483.03	9060.59	10318.31	9985.39
5	Total Input (Company Standard)	4174.80	4208.67	4242.68	10442.15	12646.29	14092.05	15367.66	15124.92
6	Normal Investor Input @ 38.48% (Industry Standard)	1617.14	1585.10	1545.49	3030.11	3813.95	4592.07	5741.39	6347.51
7	Total Input (Industry Standard)	5791.94	5793.77	5788.17	13472.26	16460.24	18684.12	21109.05	21472.43
8	Overall Input Output Ratio (Industry Standard)	1.1374	1.1884	1.1408	1.0088	1.0588	1.0111	1.0661	1.0584
9	Overall Productivity Ratio (Industry Standard)	0.8792	0.8415	0.8766	0.9912	0.9444	0.9890	0.9380	0.9448
10	Overall Productivity Indices (Industry Standard) (O)	100.00	95.71	99.71	112.75	107.42	112.50	106.69	107.47
11	Computed Value / Expected Values (E)	99.44	101.11	102.78	104.45	106.12	107.78	109.45	111.12
12	Chi-Square (O-E)2/E	0.0032	0.2880	0.0917	0.6597	0.0161	0.2061	0.0698	0.1201

Average Overall Productivity Indices=105.28, a=105.28, b=0.83, x^2=1.4547, S.D.=5.81, C.V.=5.52 %.

The highest overall productivity ratio is in the year 2013-14 with 0.9912 and the lowest is in the year 2011-12 with 0.8415. Chi-square has been used for testing the hypothesis and its table value at 5% level of significance with 8-1=7 d.f. is 14.067 while the calculated value of chi-square of Tech Mahindra Ltd. is 1.4547. As the calculated value of chi-square is less as compared to the table value hence null hypothesis is accepted. This reveals that the overall productivity ratios of the company for the eight years period are approximately the same and can be represented by straight line trend or line of best fit.

Table 5: Overall Productivity of Wipro Ltd

Base Year 2010-11 Amount in ₹ crore

S.No.	Items	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18
1	Output	26949.60	30252.87	29664.36	32941.35	35024.33	39676.31	40209.89	37750.59
2	Material Input	3805.60	4300.74	2320.50	2079.58	2254.38	2221.82	1799.82	1174.21
3	Labour Input	10937.40	12286.51	13311.82	13991.51	14143.76	14516.82	14249.07	13793.43
4	Overhead Input	6428.30	7712.28	7311.19	7873.82	8632.23	10619.01	11158.75	10980.49
5	Total Input (Company Standard)	21171.30	24299.53	22943.51	23944.91	25030.37	27357.64	27207.64	25948.13
6	Normal Investor Input @ 38.48 % (Industry Standard)	8224.47	8815.26	7424.26	8818.90	10236.65	12689.51	14670.24	12666.31
7	Total Input (Industry Standard)	29395.77	33114.79	30367.77	32763.81	35267.02	40047.15	41877.88	38614.44
8	Overall Input Output Ratio (Industry Standard)	1.0908	1.0946	1.0237	0.9946	1.0069	1.0093	1.0415	1.0229
9	Overall Productivity Ratio (Industry Standard)	0.9168	0.9136	0.9768	1.0054	0.9931	0.9907	0.9602	0.9776

10	Overall Productivity Indices (Industry Standard) (O)	100.00	99.65	106.55	109.67	108.33	108.07	104.73	106.64
11	Computed Value / Expected Values (E)	102.33	103.22	104.11	105.01	105.90	106.79	107.69	108.58
12	Chi-Square (O-E)2/E	0.0529	0.1234	0.0571	0.2069	0.0556	0.0152	0.0811	0.0348

Average Overall Productivity Indices=105.45, a=105.45, b=0.45, x^2=0.6269, S.D.=3.52, C.V.=3.34%.

Overall productivity ratio is the highest 1.0054 in 2013-14 while it is the lowest 0.9136 in 2011-12. The highest overall productivity ratio is better as from more amount of output is obtained with small amount of input. The table value of chi-square at 5% level of significance with 8-1=7 d.f. is 14.067 while the calculated value of chi-square of Wipro Ltd. is 0.6269. As the calculated value of chi-square is less as compared to the table value hence null hypothesis is accepted. This reveals that the overall productivity indices for the Wipro Ltd. for the study period are approximately same and can be represented by straight line trend or line of best fit.

KRUSKAL WALLIS ONE WAY ANOVA TEST

The overall productivity of all the samples is combined and arranged in order of increasing size and given a rank number. The rank sum of each of the sample has been calculated. The detailed calculation has been done in the following table 6.

Table 6: Comparative Overall Productivity Ratios from 2010-11 to 2017-18 of IT Sector Companies and Kruskal Wallis One Way ANOVA Test

Base Year 2010-11

Year	**Infosys Ltd.**		**Tata Consultancy Services Ltd.**		**Tech Mahindra Ltd.**		**Wipro Ltd.**	
	Ratio	Rank 1	Ratio	Rank 2	Ratio	Rank 3	Ratio	Rank 4
2010-11	1.0240	20	1.0927	25	0.8792	3	0.9168	5
2011-12	1.0497	21	1.1494	27	0.8415	1	0.9136	4
2012-13	1.0120	17	1.1158	26	0.8766	2	0.9768	10
2013-14	1.0181	18	1.1746	30	0.9912	14	1.0054	16
2014-15	1.0537	22	1.1739	29	0.9444	7	0.9931	15

2015-16	1.0683	23	1.1990	32	0.9890	12	0.9907	13
2016-17	1.0204	19	1.1540	28	0.9380	6	0.9602	9
2017-18	1.0712	24	1.1887	31	0.9448	8	0.9776	11
Total		164		228		53		83

H=26.8210

The calculated value of H is 26.8210 and the table value is 7.8147 at 5% level of significance with 4-1=3 degrees of freedom. As the calculated value is more than the table value hence null hypothesis is rejected. This means that the overall productivity ratios of the IT sector companies of Nifty 50 are not same that is there is a significant difference in overall productivity.

COMPARATIVE AVERAGE ANALYSIS

To analyse between the companies of a particular sector it is better to analyse its average performance of the study period. In the present study an attempt has been made to analyse and interpret the results on the basis of average performance.

Table 7: Comparative Average Overall Productivity of IT Sector Companies from 2010-11 to 2017-18

Base Year 2010-11

Companies	**Overall Input Output Ratio**		**Overall Productivity Ratio**		**Chi Square Test**	
	Average	Rank	Average	Rank	Value	Rank
Infosys Ltd.	0.9623	2	1.0397	2	0.286	1
Tata Consultancy Services Ltd.	0.8658	1	1.1560	1	0.314	2
Tech Mahindra Ltd.	1.0837	4	0.9256	4	1.455	4
Wipro Ltd.	1.0355	3	0.9668	3	0.627	3

The average overall input output ratio is the best of Tata Consultancy Services Ltd. by 0.8658, followed by Infosys Ltd. by 0.9623, Wipro Ltd. by 1.0355 and lastly 1.0837 of Tech Mahindra Ltd. Average overall productivity ratio is the best of Tata Consultancy Services Ltd. with 1.1560, then Infosys Ltd. with 1.0397, Wipro Ltd. with 1.0355 and lastly Tech Mahindra Ltd. with 0.9668. On analysing the chi-square of the IT sector companies it has been observed that Infosys Ltd. has the least chi-square value and Tech Mahindra Ltd. has the highest chi-square value. The table value of chi-square at 5% level of significance with 8-1=7 d.f. is 14.067. This shows that the null hypothesis based on the chi-square is accepted in all the above cases.

CONCLUSIONS

It may be concluded from the above analysis that the output per rupee of overall input is not satisfactory for all the companies of IT sector. The companies can take steps to reduce cost by optimally utilizing the material cost by improving the quality of raw material, improving technology of raw material processing and material handling transportation system. The labour cost can be optimally utilised by adopting techniques such as incentive schemes, workers participation in the management, job enrichment, flexitime, etc. Overhead productivity can be improved by reducing the expenses in overhead cost. Overhead cost such as electricity expenses can be reduced by avoiding the wastage of it. By reducing the cost it ultimately increases the productivity and hence the company becomes more productive.

SCOPE FOR FURTHER RESEARCH

This study is only based on the overall productivity of IT sector companies included in Nifty 50. More studies may be possible on other companies of other sectors of Nifty 50 and also on companies of BSE and Nifty 100. Productivity can also be calculated on the basis of individual factors such as material, labour, capital, etc.

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