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TREND AND REGRESSION ANALYSIS OF INDIAN PHARMACEUTICAL COMPANIES

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ABSTRACT

Indian drug and pharmaceutical companies are major producers of medical and pharmaceutical solutions in drugs and vaccines worldwide. In the Covid-19 pandemic, they have served a significant and remarkable way for human life-saving treatments. However, in the present study, a regression analysis has been carried out for the three noted pharmaceutical Indian multinational companies: Biocon, Cadila Pharmaceuticals and Cipla Ltd. The study is based on secondary data and data collected for a period of 10 years from 2011-12 to 2020-2021.The return on equity is taken as the independent variable whereas years taken as dependent variable. The purpose of this study is to find out the trend of relation between return on equity and years of study period. The findings indicate a strong relationship between these variables. The trend and regression analysis have found that the pharmaceutical companies' return on equity had inversely proportional trend with time i.e. the regression graphs showing downward trend with increasing time.

Keywords: *Pharmaceutical Companies, Indian, Multinational, Return on Equity, Regression Analyses*.

Introduction

The **pharmaceutical industry in India** was valued at an estimated US$42 billion in 2021. India is the world's largest provider of generic medicines by volume, with a 20% share of total global pharmaceutical exports. It is also the largest vaccine supplier in the world by volume, accounting for more than 50% of all vaccines manufactured in the world. With industry standards-compliant mega production capabilities and a large number of the skilled domestic workforce, Indian exports meet the standards and requirements of highly regulated markets of the USA, UK, European Union, and Canada. According to the Department of Pharmaceuticals, Ministry of Chemicals and Fertilizers, domestic pharmaceutical market turnover reached Rs 129,015 crore (US$18.12 billion) in 2018, growing 9.4 percent year-on-year and exports revenue was US$17.28 billion in FY18 and US$19.14 billion in FY19.

As of 2021, most of the pharmaceuticals made in India a low-cost generic drug that comprises most of pharmaceutical export of India. Patented medicines are imported. APIs are imported from China (60% supplies by volume worth US$2.4 billion) and Germany (US$1.6 billion) as well as from US, Italy and Singapore. To foster an Atmanirbhar Bharat by enhancing the R&D, Make in India product development and high-value production capabilities, import substitution and domestic manufacture of active pharmaceutical ingredient (API) the government has introduced a

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US$2 billion incentive program which will run from 2021–22 to 2027–28. In 2019 the Department of Pharmaceuticals announced that as part of the Make in India initiative, drugs for local use and exports must have 75% and 10% local APIs respectively and a bill of material must be produced for verification. During 2018–2021, India ranked third globally in terms of dollar value of drugs and medicines exports.

In the present study, three important pharmaceuticals companies of have been taken for regression analysis of past 10 years. These companies are namely Biocon, Cadila Pharmaceuticals and Cipla Ltd.

Biocon Limited

Biocon Limited is an Indian biopharmaceutical company that is based in Bangalore, India. It was founded by Kiran Mazumdar-Shaw in 1978. The company manufactures generic active (APIs) that are sold in approximately 120 countries, including the United States and Europe. It also manufactures novel biologics as well as biosimilar insulins and antibodies, which are sold in India as branded formulations. Biocon's biosimilar products are also sold in both bulk and formulation forms in several emerging markets. **Syngene International Limited** (Syngene) is a publicly listed Biocon subsidiary operating in the contract research services space.

Cadila Pharmaceuticals

Cadila Pharmaceuticals is an Indian multinational pharmaceutical company based in Ahmedabad, Gujarat, India. The company's operations focus on manufacturing products ranging from API's-Intermediates, finished formulations, OTC-Food Supplements, Biotechnology Products and pharmaceutical Machinery. Cadila Pharmaceuticals manufacturing facilities are approved by International bodies such as WHO-GMP, UK-MHRA, USFDA-API, TGA-Australia, and AIFA-Italy. The company's international operation of is spread across 58 countries including the Americas, Japan, Asia, CIS and Africa.

Cadila Pharmaceuticals is the only Indian manufacturer of natural Streptokinase and Hyaluronic Acid products. The company was also the first in the world to introduce Rabeprazole in IV form – 'Rabeloc'. In 2009, the world's first boosted-Rifampicin fixed-dose combination for the treatment of Tuberculosis – 'Risorine' and world's first drug combination for prevention of Cardiovascular Diseases – 'Polycap' were introduced by Cadila Pharmaceuticals. For the patients with Non Small Cell Lung Cancer (NSCLC), the company introduced 'Mycidac-C' - first in the class active immunotherapy as well as drug targeting Desmocollin. Some of the top brands of the company are Aciloc, Envas, Calcirol, Haem Up, Vasograin, Tricort, Fludac, Rabiloc, Trigan-D, Mycobutol and Sepsivac.

Cipla Ltd

Cipla Limited is an Indian multinational pharmaceutical company, headquartered in Mumbai, India. Cipla primarily develops medicines to treat respiratory disease, cardiovascular disease, arthritis, diabetes, depression and many other medical conditions. As of 17 September 2014, its market capitalisation was Rs.49,611.58 crore (equivalent to US$7.1 billion in 2020), making it India's 42nd largest publicly traded company by market value. In 1985, the US FDA approved the company's bulk drug against HIV and other drugs to treat poor people in the developing world. Cipla offered antiretrovirals for HIV treatment at a fractional cost (less than $350 per year per patient).

Cipla sells active pharmaceutical ingredients to other manufacturers as well as pharmaceutical and personal care products, including escitalopram oxalate (anti-depressant), lamivudine, and fluticasone propionate. They are the world's largest manufacturer of antiretroviral drugs.

In July 2020, the company announced the introduction of Gilead Sciences' *Remdesivir* under the brand name **CIPREMI** in India after reaching a voluntary licensing agreement with parent company and DCGI approval for "restricted emergency use" in COVID-19 treatment of critical confirmed patients.

Review of Literature

Recent patent-law changes in India's pharmaceutical industry provide opportunities to study changes of institutional and regulatory environments on innovation and social welfare in low-income markets. From 1972 to 2004 under its process-patent regime, India's pharmaceutical industry grew to become the world's fourth largest. Indian companies were becoming globally competitive in generics and clinical testing, and moving into product R&D. Researchers have debated the effects of India's new product-patent laws' effects on these trends. The authors cover the domestic characteristics and global competitiveness of India's pharmaceutical industry. They contrast data (from 2001 to 2004) on patents in

India's process-patent regime with preliminary data (from 2005 to 2008) on patents in the country's new product-patent regime. They argue that Indian pharmaceutical companies have changed their decision-making in response to changed patent laws by moving from process to product research. However, the preliminary results indicate that these changes may have hurt domestic innovation. They conclude with strategic implications for the Indian pharmaceutical industry and highlight the need for research and public policy to establish optimal social returns from product-patent regimes (George T.Haley and Usha C.V. Haley, 2012). Regression analysis is widely used in evaluation and prediction, and fuzzy least absolute regression is preferred when data is fat-tailed or out-linear (Lisheng Jiang and HuchangLiao, 2020)**.**

Regression analysis is used by mathematicians and data scientists alike for prediction and forecasting. It involves fitting the right model with respect to the given data set and then using that model to make further predictions. The ideal model showcases all the relationships accurately. Naturally, a tool based on regression analysis can provide valuable insights to an economist or a manager. Regression analysis is a very important tool for a Data Scientist working with Data Sets. To yield the correct results from different types of Data Sets with different relationships, different types of Regression Analysis models are used (Gupta A., Sharma A. and Goel A., 2017).

Objectives

The main objectives of the present research work are:

- To conduct simple regression analysis of Indian pharmaceutical companies under study for last 10 years from 2011-12 to 2020-21.
- To find out the trend of return on equity of these companies during the period under study.

Research Methodology

Research methodology refers to the precise processes or methods used to trace, pick, organize, and analyze information on a problem. The methodology part of a research article gives the reader the chance to assess the study's total credibility and dependability.

- **Sample**: The sample included three companies from pharmaceutical industry that are listed in under BSE-200.
- **Period of Study**: This study covers the period of the last 10 years from 2011-2012 to 2020-2021.
- **Data Collection**: During a research study, data collection is an important task for the researcher. This study is primarily based on secondary data gathered from annual reports and accounts of the companies under consideration.
- **Variables of Study:** The study is conducted for regression analysis in which return on equity ratios of pharmaceutical companies namely: Biocon, Cadila Pharmaceuticals and Cipla have been plotted against years of study period.

The return on equity ratio can be described as a financial ratio that helps measure a company's proficiency to generate profits from its shareholders' investments. This profitability helps to gauge a company's effectiveness when it comes to using equity funding to run its daily operations. By figuring out the ROE of a company, individuals can find out how much post-tax income is left in its reserve. Subsequently, one can compare net income to the total shareholder equity as recorded on its balance sheet. ROE ratio also helps you understand how a company compares to other firms in the same industry and evaluate the company's financial performance and asset valuation.

The ROE ratio is calculated by dividing the net income of the company by total shareholder equity and is expressed as a percentage. The ratio can be calculated accurately if both the net income and equity are positive in value.

Return on equity ratio formula is expressed as:

Return on Equity = Net Income / Average Shareholder's Equity

Here, net income is computed before dividends are allocated to the common shareholders. Further, it is calculated after dividends are paid out to preferred shareholders, and interest is paid to lenders.

In the present study, regression analysis has been carried out for Biocon, Cadila Pharmaceuticals and Cipla companies.

Regression Analysis

Table 1 shows regression analysis of Biocon Ltd.'s return on equity ratio for the past 10 years.

Table 1: Regression Analysis of Biocon Ltd.'s Return on Equity Ratio (2011-12 to 2020-21)

X-Values	Y-Values	$X - M_x$	$Y - M_y$	$(X - M_x)^2$	$(X - M_x)(Y - M_y)$
18.08	2012	3.093	-4.5	9.5666	-13.9185
14.89	2013	-0.097	-3.5	0.0094	0.3395
18.89	2014	3.903	-2.5	15.2334	-9.7575
13.67	2015	-1.317	-1.5	1.7345	1.9755
15.21	2016	0.223	-0.5	0.0497	-0.1115
13.64	2017	-1.347	0.5	1.8144	-0.6735
12.65	2018	-2.337	1.5	5.4616	-3.5055
07.18	2019	-7.807	2.5	60.9492	-19.5175
14.84	2020	-0.147	3.5	0.0216	-0.5145
20.82	2021	5.833	4.5	34.0239	26.2485
				SS = 128.8644	**SP = -19.435**

Fig. 1 shows regression graph for Biocon taking years as dependent and return on equity ratio as independent variable.

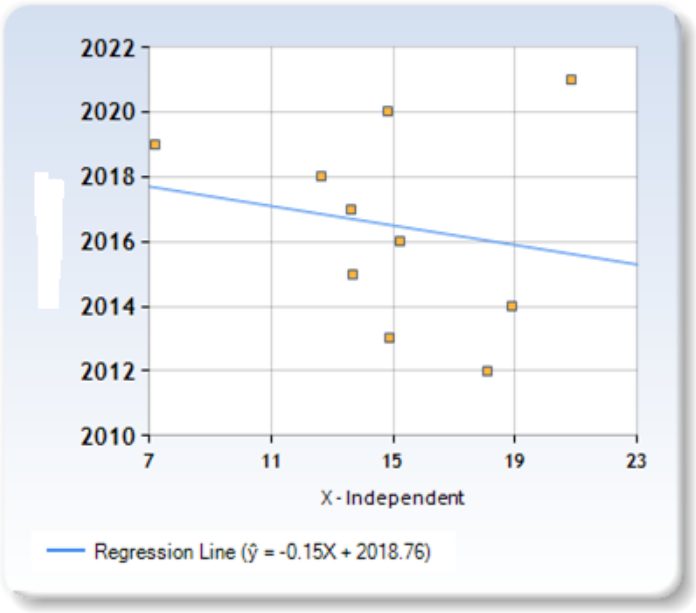

Fig. 1: Graphical presentation of Regression analysis of Biocon Ltd.

Calculation

Sum of X = 149.87
Sum of Y = 20165
Mean X = 14.987
Mean Y = 2016.5
Sum of squares (SS_X) = 128.8644
Sum of products (SP) = -19.435
Regression Equation = $\hat{y} = bX + a$
$b = SP/SS_X$ = -19.44/128.86 = -0.15082
$a = M_Y - bM_X$ = 2016.5 - (-0.15*14.99) = 2018.7603
$\hat{y}$ = -0.15082X + 2018.7603
Hence, for data of **Biocon**, the regression equation for Y is:
$\hat{y}$ = -0.15082X + 2018.7603

Table 2 shows regression analysis of Cadila Pharmaceuticals Ltd's return on equity ratio for the period from 2011-12 to 2020-21.

Table 2: Regression Analysis of CadilaLtd's Return on Equity Ratio (2011-12 to 2020-21)

X-Values	Y-Values	$X - M_x$	$Y - M_y$	$(X - M_x)^2$	$(X - M_x)(Y - M_y)$
29.2	2012	7.36	-4.5	54.1696	-33.12
25.79	2013	3.95	-3.5	15.6025	-13.825
17.12	2014	-4.72	-2.5	22.2784	11.8
24.89	2015	3.05	-1.5	9.3025	-4.575
28.08	2016	6.24	-0.5	38.9376	-3.12
32.46	2017	10.62	0.5	112.7844	5.31
10	2018	-11.84	1.5	140.1856	-17.76
14.08	2019	-7.76	2.5	60.2176	-19.4
17.33	2020	-4.51	3.5	20.3401	-15.785
19.45	2021	-2.39	4.5	5.7121	-10.755
				SS = 479.5304	**SP = -101.23**

Fig. 2 shows regression graph for Cadila Pharmaceuticals taking years as dependent and return on equity ratio as independent variable.

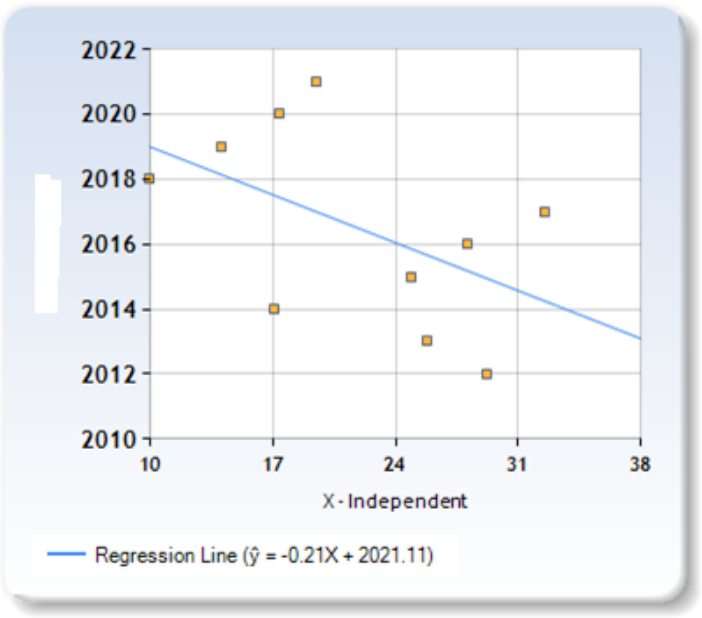

Fig. 2: Graphical presentation of Regression analysis of Cadila Pharmaceuticals Ltd.

Calculation

Sum of X = 218.4
Sum of Y = 20165
Mean X = 21.84
Mean Y = 2016.5
Sum of squares (SS_X) = 479.5304
Sum of products (SP) = -101.23
Regression Equation = $\hat{y} = bX + a$
$b = SP/SS_X$ = -101.23/479.53 = -0.2111
$a = M_Y - bM_X$ = 2016.5 - (-0.21*21.84) = 2021.11048
$\hat{y}$ = -0.2111X + 2021.11048
Hence, for **Cadila Pharmaceuticals** data, the regression equation for Y is:
$\hat{y}$ = -0.2111X + 2021.11048

Table 3 shows regression analysis of Cipla Ltd's return on equity ratio for the period from 2011-12 to 2020-21.

Table 3: Regression Analysis of CiplaLtd's Return on Equity Ratio (2011-12 to 2020-21)

X-Values	Y-Values	$X - M_x$	$Y - M_y$	$(X - M_x)^2$	$(X - M_x)(Y - M_y)$
14.54	2012	1.951	-4.5	3.8064	-8.7795
14.9	2013	2.311	-3.5	5.3407	-8.0885
17	2014	4.411	-2.5	19.4569	-11.0275
13.76	2015	1.171	-1.5	1.3712	-1.7565
10.65	2016	-1.939	-0.5	3.7597	0.9695
12.2	2017	-0.389	0.5	0.1513	-0.1945
7.61	2018	-4.979	1.5	24.7904	-7.4685
10.4	2019	-2.189	2.5	4.7917	-5.4725
11.96	2020	-0.629	3.5	0.3956	-2.2015
12.87	2021	0.281	4.5	0.079	1.2645
				SS = 63.9431	**SP = -42.755**

Fig. 3 shows regression graph for Cipla Ltd taking years as dependent and return on equity ratio as independent variable.

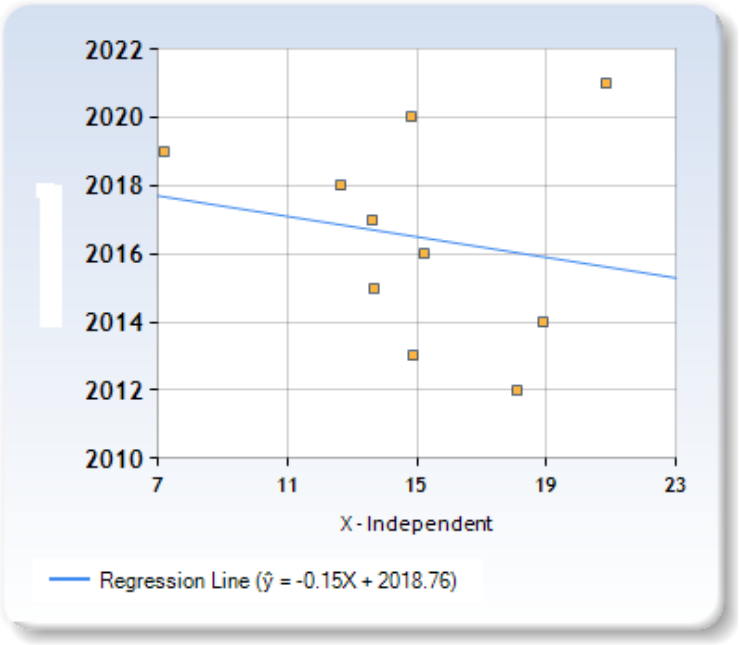

Fig. 3: Graphical presentation of Regression analysis of Cipla Ltd.

Calculation

Sum of X = 125.89
Sum of Y = 20165
Mean X = 12.589
Mean Y = 2016.5
Sum of squares (SS_X) = 63.9431
Sum of products (SP) = -42.755
Regression Equation = $\hat{y} = bX + a$
$b = SP/SS_X$ = -42.76/63.94 = -0.66864
$a = M_Y - bM_X$ = 2016.5 - (-0.67*12.59) = 2024.91753
$\hat{y}$ = -0.66864X + 2024.91753
Hence, for **Cipla Ltd** data, the regression equation for Y is:
$\hat{y}$ = -0.66864X + 2024.91753

Regression analysis can result in *linear* or *nonlinear* graphs. A linear regression is where the relationships between dependent and independent variables can be described with a straight line. Non-linear regressions produce curved lines. In present study, there is a linear regression in each company's dependent and independent variables.

From the above analysis, we get following regression equations for pharma companies under study-

$\hat{y}$ = -0.15082X + 2018.7603 …(1) Biocon

$\hat{y}$ = -0.2111X + 2021.11048 …(2) Cadila Pharm

$\hat{y}$ = -0.66864X + 2024.91753 …(3) Cipla

From these equations, it is clear that Biocon has slope `*b*' value **minimum** which is equal to -0.15082, then Cadila Pharmaceuticals has -0.2111 and Cipla having **maximum slope** -0.66864. Also, the constant value `*a*' for Biocon is 2018.7603 (minimum), 2021.11048 for Cadila Pharm and 2024.91753 (maximum) for Cipla Ltd. It means starting point of regression line i.e. intercept at y-axis, goes higher and higher from Biocon to Cadila to Cipla and slope goes down and more down in same order. It can be seen from Figs. 1, 2 and 3 respectively.

Table 4: Test of Significance

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.124	0.215		23.863	
	Biocon	-0.151	.018	-0.143	9.257	0.127
	Cadila Pharm	-0.211	.018	-0.203	38.483	0.162
	Cipla	-0.669	.037	-0.647	-2.458	0.184

As all the significance values are higher than 0.05, it means null hypothesis is rejected and it is concluded that the independent variables are linearly related to the dependent variable as shown in Figs. 1, 2 and 3. Also it can be noted here that negative beta coefficient values indicate that independent and dependent variables are inversely proportional to each other which is clear from downward slope of regression line in each Figure.

Conclusion

- **Findings:** The regression analysis of pharmaceutical companies shows that there is an inverse linear relation between dependent and independent variables which are- time (in years) and return on equity, respectively. From this analysis, it can be concluded that Biocon Ltd, Cadila Pharmaceutical Ltd and Cipla Ltd have downward regression line. Beta value increased but with negative sign and alpha value increased with positive sign in equations (1), (2) and (3). As a result, graphs of these equations having downward trend and the slope of regression lines increased but in down side.
- **Result:** Return on equity of Biocon, Cadila Pharmaceutical and Cipla Ltd showed linear correlation with time from 2011-12 to 2020-21 but having down trend which should be improved.
- **Impact:** From this regression analysis, managements of these companies can make their future business strategy so that these companies left down trend and improve ROE to maintain confidence of their shareholders.

References

1. Aiken, L. S. and West, S. G. (2011). Multiple regression: Testing and interpreting interactions. Thousand Oaks, CA: Sage.
2. Aviral Gupta, Akshay Sharma and Amita Goel (2017). Review of Regression Analysis Models, Int. Journal of Engg. & Tech., 6(8), August 2017, 58-61.
3. "Biocon Consolidated Profit & Loss account, Biocon Financial Statement & Accounts". www.moneycontrol.com. Retrieved 31 July 2020.
4. "Biocon Consolidated Balance Sheet, Biocon Financial Statement & Accounts". www.moneycontrol.com. Retrieved 31 July 2020.

5. "Biocon Ltd: About Biocon Pharma Company Founder, CEO, Products & Contact Address". www.brandindiapharma.in. Retrieved 8 February 2018.
6. "Cadila Pharmaceuticals Ltd". CPhI Worldwide - Uniting the Pharmaceutical Industry. 13 September 2018.
7. "Cadila Pharma". Archived from the original on 21 April 2014. Retrieved 24 March 2014.
8. "Cadila Pharmaceuticals launches Polycap, which reduces cardiovascular and stroke risk substantially". The Financial Express. 2 April 2009.
9. "Cadila Pharma inks pact with Norwegian start-up to develop new treatment for heart patients". @businessline. Retrieved 11 January 2019.
10. "Cipla Consolidated Profit & Loss account, Cipla Financial Statement & Accounts". www.moneycontrol.com. Retrieved 28 July 2020.
11. "Cipla Consolidated Balance Sheet, Cipla Financial Statement & Accounts". www.moneycontrol.com. Retrieved 28 July 2020.
12. Field, A. (2013). Discovering statistics using SPSS (4th ed.). London: Sage.
13. George T.Haley and Usha C.V. Haley (2012). The effects of patent-law changes on innovation: The case of India's pharmaceutical industry, Technological Forecasting and Social Change, 79(4), May 2012, 607-619.
14. Green, S. B. (1991). How many subjects does it take to do a regression analysis? Multivariate Behavioral Research, 26(3), 499–510.
15. Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Multivariate data analysis. A global perspective (7th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.
16. Lisheng Jiang and Huchang Liao (2020). Mixed fuzzy least absolute regression analysis with quantitative and probabilistic linguistic information, *Fuzzy Sets and Systems*, Vol. 387, 15 May 2020, 35-48.
17. Nimmi. "Biocon, India's largest biotech company". www.indianmirror.com. Retrieved 8 February 2018.
18. "Top Companies by Market Capitalisation". Money Control. 17 September 2014. Retrieved 17 September 2014.