Mergers and Acquisitions in the Indian Context : A Valuation Perspective for the Indian Pharmaceutical Industry

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Abstract

Mergers and acquisitions (M&A) as a strategy has been used increasingly by the corporate sector to gain a competitive advantage. Mergers and acquisitions (M&A) help a firm gain new customer bases, enter new markets, gain access to new technologies, and help achieve cost reduction. In today's time, firms try to achieve synergistic gains through M&As. This study aimed to: a) understand if prices paid by acquiring firms reflected synergistic gains and b) observe value created for shareholders of the acquiring firms. The study used secondary data for the purpose of research. A neural network model was built to scrutinize the impact of the selected variables on the value of the mergers and acquisitions (M&A) deal. An event study was carried out to assess value creation for shareholders of the acquiring firm. The study found that an acquiring firm generally paid more during the M&As compared to the synergistic gains it realized post-acquisition. Additionally, there was no value creation for the acquiring firm's shareholders. The neural network model from this study, with appropriate variables, can be used to predict the price of an M&A deal. The study will benefit the stakeholders of pharmaceutical firms to make informed decisions regarding mergers and acquisitions.

Keywords : **mergers and acquisitions, synergy valuation, artificial neural network, pharmaceutical sector, event study**

JEL Classification Codes : G34, G30, L65

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Corporates worldwide use the strategy of mergers and acquisitions to gain an advantage over their competition. M&As help a firm achieve synergistic gains by acquiring a new customer base, entering new markets, gaining access to new technologies, and helping achieve cost reduction. The purpose of these M&As is to positively affect the firm's business and help the firm achieve the desired business outcomes.

There are two schools of thought as to why firms participate in mergers & acquisitions. Chatterjee (1986) reported the monopoly theory, which states that the firms use the M&A route to raise their market share and power. Shelton (1988) reported the efficiency theory. This theory states that M&As are planned and executed for cost reduction by achieving economies of scale. In addition to these schools of thought, Damodaran (2005) reported that synergistic gains are one of the primary reasons for M&A deals.

Whenever the value of the combined firm is greater than the sum of the target and acquirer as individual firms, it is said to result in synergistic gains. These gains are achieved by combining firms in the same industry/sector

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(operational synergy), or by combining firms with different managerial resources (managerial synergy), or by combining firms with different financial resources (financial synergy).

Several policy reforms are responsible for creating the wave of M&A activities in India. The changes introduced in the industrial policies in 1991, the abolishment of prohibitive provisions of the Monopolies and Restrictive Trade Practices (MRTP) Act, the changes in the Foreign Exchange Regulation Act (FERA) in 1993, and the Foreign Exchange Management Act (FEMA) in 2000 mainly played a significant role. Broad industry groups such as electronics, machinery, beverages, pharmaceutical, chemical, financial, and other services often experience M&A deals.

The reasons for picking the pharmaceutical industry for this study particularly, and not any other sector, are as follows. Firstly, Mishra (2006) reported that the drugs and pharmaceuticals industry had witnessed several M&A deals, and the majority of these M&As were horizontal in nature. Secondly, the Indian pharmaceutical firms could not raise their market share even after several M&A deals, which refutes the monopoly theory reported by Chatterjee (1986). Additionally, business consolidation and strengthening of R&D were the basis for many of the deals. Hence, the firms may have benefitted through synergistic gains instead of any visible increase in market power. Also, the demand for drugs is inelastic due to an intermediary (i.e., a doctor). A doctor impacts the demand for the drug because the actual customer (the patient) has to follow the doctor's recommendation to consume any drug. Under this environment, the consolidation strategies can increase market concentration, thereby raising the supply side's power. Due to the above reasons, mergers & acquisitions in the pharmaceutical sector deserve special attention. Although more and more pharmaceutical firms engage in M&As from a synergistic gains point of view, a lack of detailed reports supporting the same is evident. As opposed to the earlier theories, which are slowly losing relevance, more studies around the synergistic gains are a need of the hour. This paper tries to analyze if the firms can understand the synergistic gains and if that reflects in the paid valuation prices. Theoretically, the M&A should also lead to value creation for the firm's shareholders. Thus, the paper analyzes the value creation aspect through an event study.

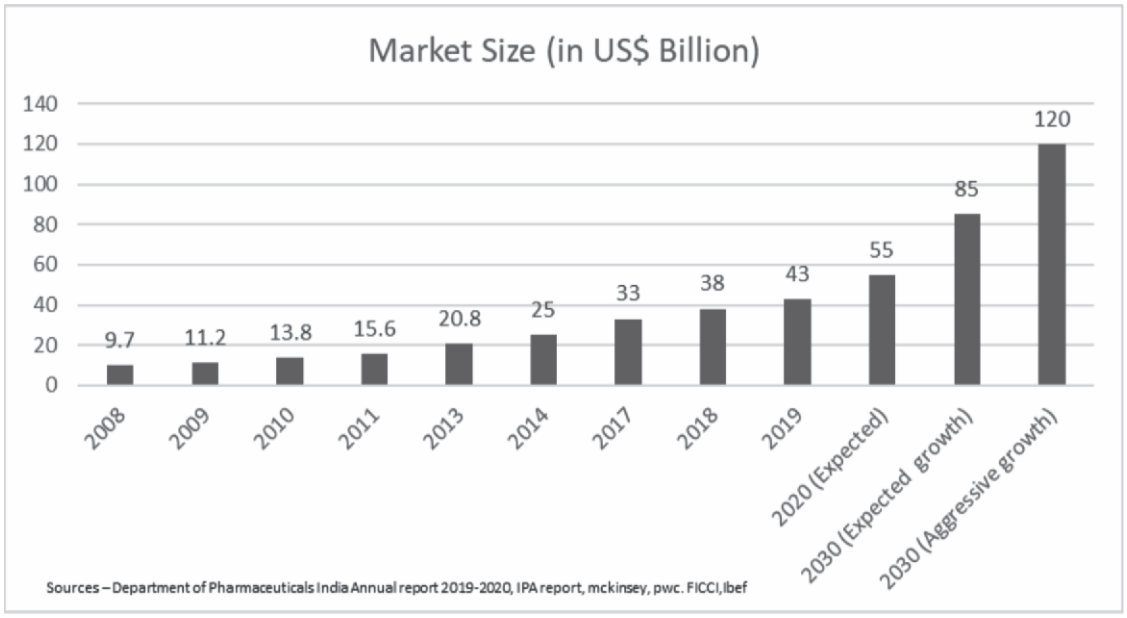
In relation to the above review of M&A activity, the paper attempts to identify the factors and critical drivers that lead a firm to indulge in M&A activity. It also tries to analyze the various profitability measures of merging vs. not merging firms. This study is also a first of its kind as it employs a neural network model to predict valuation for target firms in the pharmaceutical sector.

The Indian Pharmaceutical Industry : An Overview

The Indian pharmaceutical industry plays a vital role in improving health outcomes in India and across the globe with the help of its affordable and high-quality drugs. The efficiency with which Indian pharmaceutical companies handled the COVID-19 situation reinforces the global importance of this industry. While the Indian pharmaceutical industry is highly organized and regulated, it is also highly fragmented. There are around 3,000 pharma companies and over 10,500 manufacturing facilities in India. The industry started around 1970 – 1980 after the government passed the 1970 Patent Act, and it now has a prominent and fast-growing presence in the global pharmaceutical market. It ranks 13th worldwide by value and third for production by volume. India accounts for 10% of the world's production by volume and 2% by value.

The Indian pharmaceutical industry (drugs & medical devices included) was valued at (Figure 1) US$ 43 billion in 2019, which shows a healthy ~15% YOY growth rate. Further, a 7 – 8% growth is projected, which translates to a value of US$ 80 – 90 billion for the industry by 2030. Some projections even predict an aggressive growth rate of 11–12% for the Indian pharma industry. Our exports satisfy about 20% of the global generic drugs' demand by volume. India exports 50% of its total production to around 200 countries. The Indian pharmaceutical industry fulfills over 50% of various global vaccine demands, 40% of the generic drug demand in the US, and 25%

Figure 1. ***Indian Pharmaceutical Industry Market Size***



of all medicinal requirements in the UK. India is now known as the "pharmacy of the world" because of its impact on the global industry. The following are some of the known reasons for India's success:

↳ ***Low Cost of Production.*** The manufacturing cost is about 33% lower than that of the US and about 40% lesser than other manufacturing hubs.

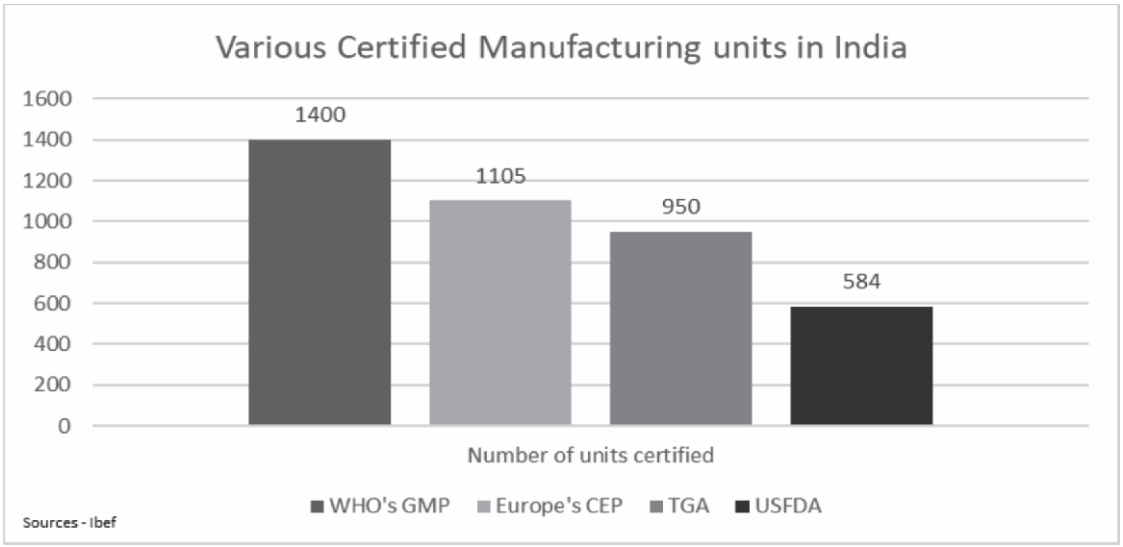
↳ ***Skilled Manpower.*** We have a highly innovative and talented workforce in terms of scientists and researchers, which is a requirement of this industry; simultaneously, the cost of the workforce is low.

↳ ***Several Regulatory Approved Manufacturing Units.*** The highest number of USFDA (Figure 2) approved factories outside the US are present in India. Manufacturing units with other necessary certifications like GMP or CEP are present in India too. These units have primarily contributed to manufacturing high-quality products in the country. India has about 1,400 good manufacturing practice certified units (GMP prescribed by WHO) and 584 USFDA certified units (USFDA prescribed by the USA). India also has 950 therapeutic goods administration certified units (TPA prescribed by Australia) and 1,105 Certificate of Suitability certified units (CEP prescribed by the European Union). These various certified manufacturing units, coupled with the fact that the Indian pharmaceutical industry is one of the most highly regulated industries worldwide, allow India to manufacture and export drugs worldwide.

↳ ***CRAMS Sector.*** Globally, India's CRAM sector is well-known for its high-end research services and is amongst the fastest-growing segments of the country's pharmaceutical industry. Low R&D costs make it a favorable option too.

↳ ***Increased Investments.*** Increasing the number of investments in this sector in the form of M&As or JVs has occurred in the past few years.

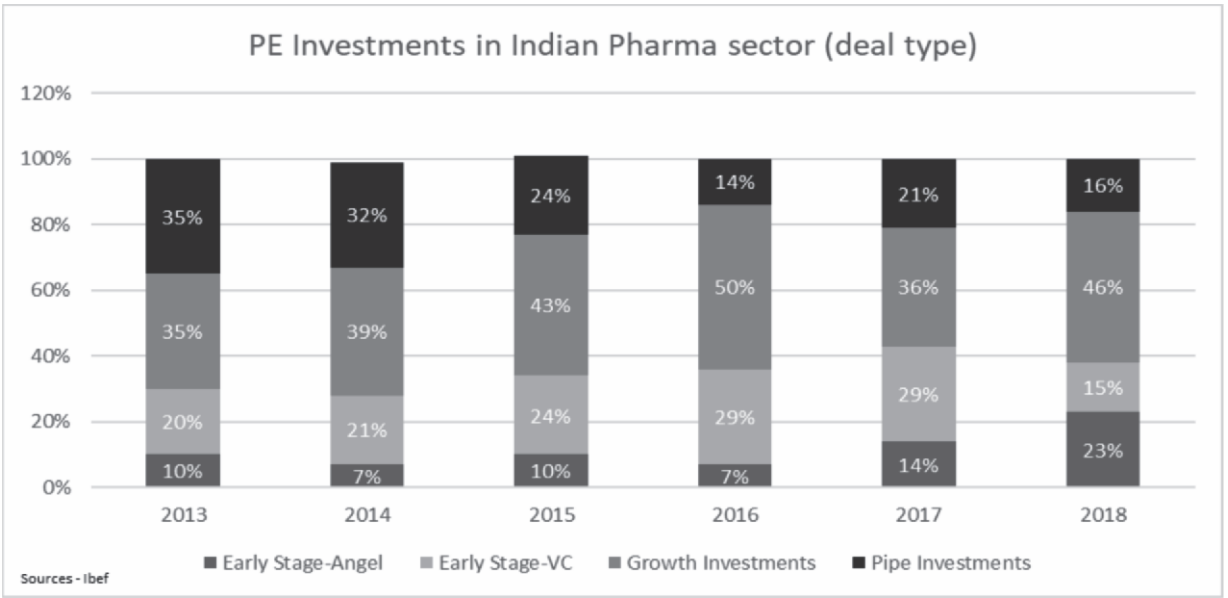
Figure 2. ***Certified Indian Manufacturing Units***



↳ ***Policy Support.*** The government has developed "Pharma Vision 2020." To support this vision, it has increased its spending in the health sector and has introduced a few favorable policies that match global standards. Between April 2000 and December 2019, cumulative FDI worth US$ 16.39 billion was invested in the Indian drugs & pharmaceuticals sector. In the past three years, 70% of M&A deals observed were in the pharmaceuticals sector.

The Indian pharma sector is emerging as the new darling for PE investors (Figure 3) because it pushes to be the manufacturing hub and new drug development hub of the world.

Figure 3. ***Various Types of Private Equity (PE) Investments in the Indian Pharmaceutical Sector***



Literature Review

Numerous studies can be found in the literature aimed at examining the performance of M&A activities by analyzing pre-and post-merger deals in the Indian pharmaceutical industry. Mergers and acquisitions are now a vital strategy the business world uses to create and maintain a competitive edge through cost reduction, tax benefits, and increased market share. Organizations restructure themselves by increasing their product portfolio, diversifying their business as a process, and compensating for stagnant growth in the home market. After liberalization and globalization policies, India experienced massive improvements in research and development, which is very important for the pharmaceutical industry, ultimately leading to a wave of mergers and acquisitions that led to consolidation in the sector, giving Indian pharmaceutical firms a competitive advantage.

The efficiency theory explains the primary rationale behind prospective mergers & acquisitions activity. The theory states that mergers & acquisitions activity help achieve synergies, including financial, operational, and managerial, for the acquiring or merging firms.

A study conducted on the Indian pharmaceutical industry by Beena (2006) reported that due to the consolidation, merging firms achieved massive cost reduction from the year 2000 to 2005. They successfully eliminated wasteful expenses, which resulted in improved financial results compared to non-merging firms in the industry during that period.

Post examining the various determinants of mergers & acquisitions in pharmaceutical and biotech firms, Danzon et al. (2007) reported that if the firm's purpose was to accomplish economies of scale, then the smaller firms should be busy participating in M&A activity. However, as opposed to the assumption, more prominent firms (defined based on EV) are the ones that are most active in M&A deals. They also reported that the firms with a high inclination towards merging tend to have lower research & development expenses than those that do not participate in M&A deals. They also stated that the rationale between mergers and acquisitions was the excess capacity that arose due to patent expirations and the gap in the pipeline of drugs, making current physical and human capacity surplus as compared to the actual need. Thus, M&As provide a chance to companies to revamp their asset base. In their study, the effect of the variable drug life (measured by the percentage of firm's drugs that are old and at risk of losing patent protection) was significant and positive. The effect mentioned above affirms that a vital rationale for firms entering mergers & acquisitions is their upcoming patent expiration and its impact on labor productivity and revenue.

After conducting a study to find various determinants of M&A activity in the Indian pharmaceutical sector using logit analysis and cross-tabulation, Vyas et al. (2012) reported that big global firms invest more in mergers and acquisitions to gain surplus capacity and research & development investments to reorient and consolidate their position and thereby achieve synergies in work. Furthermore, the smaller firms whose expansion plans halted due to inadequate resources can look at merging with big conglomerate firms to gain accessibility to the resources and thereby generate more market demand. Moreover, by using the cross-tabulation method, it was reported that a sizeable gap existed concerning technology requirements before the liberalization policy came into the picture. Hence, the government developed R&D-related policies to identify new prospects so that the firms could then deviate their R&D efforts to these prospects.

Tripathy and Prajapati (2014) reported that mergers and acquisitions had remained sluggish after 2013 due to various reasons like negative financial results, deferral of antitrust action, and stringent and laborious processes.

After examining the influence of mergers and acquisitions on the performance (financial & operating) of listed Indian pharmaceutical companies (BSE & NSE) from 2005 – 2010, Duggal (2015) reported that the effect on the profitability of acquiring firms was positive. They benefitted from the deal but only in the short term (+1 years), and this was not sustainable in the long term after post-merger (+5 years). There was an increase in EBIT, profit margin, and cash in the short run, but it lasted only for 1–2 years and was not sustainable in the long run.

Post-merger and acquisition of a company, the acquirer company's shareholders expect wealth creation due to the new synergy created. Raghuvanshi and Raghuvanshi (2014) concluded that shareholders' gains from target companies were higher than the acquiring companies' gains. The higher premiums paid during the acquisition positively impacted the target company's shareholders. Further, Ranju and Mallikarjunappa (2017), after analyzing acquisition announcement news impact for various Indian companies, concluded that acquirer company shareholders did not create wealth or value post acquisitions.

However, Prakash (2017) had a contrary view. He stated that there was little abnormal return leading to value creation for shareholders of acquiring company post-acquisition and value destruction for target Indian company's shareholders. This statement contradicts the existing literature's belief that the target company shareholders create wealth and acquirer company shareholders lose wealth.

Financial forecasting is an essential aspect of valuation. Researchers have now moved to more sophisticated and advanced financial modeling techniques using machine learning. Sarangi et al. (2019) pointed out that among various models, the neural network has proven to be a popular choice among researchers for financial modeling. In their paper, Zhu and Meng (2021) valued the synergy through financial indicators using the neural network model for China-based pharmaceutical companies. They concluded that their neural network model could predict the synergy valuation accurately and thus had a tremendous practical significance over traditional valuation methods.

As observed from the literature, various authors have tried to study the impact of wealth creation during mergers and acquisitions and tried newer valuation models to value synergy. The available research has focused on the overall economy without any specific emphasis on a single industry and the use of machine learning tools like neural network models have found little mention or use as a sophisticated valuation tool in the Indian context. Hence, a more focused analysis of the pharmaceutical industry is needed to understand the impact of mergers and acquisitions on various aspects.

Objectives of the Study

- To observe if any value is created for shareholders in the M&A transactions.
- To observe if the synergistic gains are reflected in the prices paid by the acquiring company in the respective M&A transactions.

Hypotheses

- **H01 :** There is no value generation for the shareholders of an acquiring company after an M&A deal.
- **Ha1 :** There is value generation for the shareholders of an acquiring company after an M&A deal.
- **H02 :** The acquiring company inaccurately determines the synergy gains, and it is not reflected in the prices.
- **Ha2 :** The acquiring company correctly determines the synergy gains, and it is reflected in the prices.

Methodology

Secondary data were collected using the Bloomberg database. A total of 106 deals were identified post which data of only 36 deals was considered as the value of deal data was available only for those deals, an essential criterion for the study. R software was used to analyze the event study and to develop a neural network model. The study was carried out in the year 2020 – 2021 in India.

Scope

The Indian pharmaceutical M&A deals that fulfilled the below-given criteria were selected for the study:

- The acquirer and the target company should be from the pharmaceutical sector.
- The acquirer should be listed on the Indian stock exchange.
- The M&A deals were announced and completed from 01/01/2000 to 31/12/2019.
- The target can also include portfolios of drugs and rights of drugs apart from companies, as these are more common in this sector.

106 M&A deals were identified using the Bloomberg database that satisfied the above criteria. Out of these 106, the data regarding the deal value was available only for 36 deals. Hence, for the analysis, the data of these 36 deals will be used.

Event Study

The value generated by the company might also be enjoyed by the shareholders of the company. The shareholders enjoy the value in terms of returns on their shares. So, to study if the shareholders benefit from the M&A deals, an event study was conducted across time periods which were: (t–30, t+30), (t–15, t+15), (t–5, t+5), (t–1, t+1). Cumulative abnormal returns were calculated to understand the gains. The announcement date was considered the event date for the study. For the event study, 34 deals were considered.

The abnormal returns were calculated through the following formula:

$ABR = RS - RM$

where,

ABR stands for abnormal return,

RS for return on the stock,

RM for return on the market (BSE Sensex in our case).

The cumulative abnormal return (CAR) was then calculated by adding all the abnormal returns calculated for each of the days.

Neural Network

Most M&A deals are done with the idea that there will be a synergy formation after the deal, which means that the value generated is more in the merged entity than when both entities function standalone. A neural network model was designed to test this to understand if any synergistic value was generated in the M&A transactions. The model was trained first and then validated using the remaining testing data. Thus, the data was divided into two parts: 25 deals' data was used to train the model, and 11 deals' data was used to test the model. Changes in the following variables were used in the model:

- Asset turnover (ATR),
- Current ratio (CR),

- Debtors turnover (DTR),
- Equity (EQ),
- Investments (INV),
- Inventory turnover (ITR),
- Net profits (NP),
- Net profit margin (NPM),
- Net sales (NS),
- Return on capital employed (ROCE).

The rationale behind choosing the above variables is as follows:

- Profitability is generally an indicator of the price or worth of a company. A firm with high quality of assets and strong profitability attracts better deals. Variables like net profit margin, net profits, and return on capital employed have been used for this study as they are also used to calculate profitability.

- Companies priced higher are expected to have a higher expected growth rate. With increased asset capacity and investment power, it is expected of the company to aim for exponential growth in profits. Thus, increased profit, sales and equity, and investments can measure a company's growth.

- For pharmaceutical companies, asset management is very important and can affect the price of a company. Asset turnover and inventory turnover are used to measure a firm's asset management.

- A firm with strong short-term and long-term solvency will command a higher price. Thus, the current ratio and debtor's turnover measure solvency.

- The change was calculated as the difference between the two financial years before and after the merger. The reason is that after the M&As, the value for the acquiring company should increase, and this should be reflected in the financial variables of the company as well. These variables have been selected as per the models available in the literature.

Analysis and Results

Results of Event Study

Cumulative Abnormal Returns (CAR)

The event study addresses the first hypothesis and helps us understand if shareholders of an acquiring company gain or lose after an M&A deal. Important events like lawsuits, buyouts, mergers and acquisitions, etc., affect the stock prices as well. As cost synergies drive M&As, it is believed that such M&As should also create extra wealth for shareholders. Hence, to check this hypothesis, cumulative abnormal returns for the acquiring company have been calculated. Since most of the target companies are not listed, they have not been included in the study. Basically, an event study was done for all the acquiring companies involving four time frames: (t–30, t+30), (t–15, t+15), (t–5, t+5), (t–1, t+1).

Thus, if there is wealth creation for shareholders, then the mean of CAR post-M&A event should be higher than the CAR before the event. After calculating the CAR for all four time frames, a one-tailed paired t-test was performed to compare the means of CAR.

The hypothesis of the one-tailed paired *t*-test is as follows:

↳ **H0 :** The mean CAR before the M&A event is lower or equal to the mean CAR after the M&A company for the acquiring company shareholders.

↳ **Ha :** The mean CAR before the M&A event is higher than the mean CAR after the M&A company for the acquiring company shareholders.

As observed in Table 1, the p-value is greater than 0.05, and thus, we cannot reject the null hypothesis of the one-tailed paired *t*-test.

As observed in Table 2, the *p*-value is greater than 0.05, and thus, we cannot reject the null hypothesis of the one-tailed paired *t*-test.

Table 1. ***t - test Result Table for T – 30 and T + 30 Timeframe***

***t*-Test: Paired Two Sample for Means**		
	***T* – 30**	***T* + 30**
Mean	1.181155427	0.226266998
Variance	66.30940016	84.92297073
Observations	34	34
Pearson Correlation	–0.20310819	
Hypothesized Mean Difference	0	
Df	33	
t - Stat	0.413043953	
P (*T*< = *t*) one-tail	0.341123017	
t Critical one-tail	1.692360309	
P (*T* < = *t*) two-tail	0.682246034	
t Critical two-tail	2.034515297	

Table 2. ***t - test Result Table for T–15 and T+15 Timeframe***

t - Test: Paired Two Sample for Means		
	***T* – 15**	***T* + 15**
Mean	0.094987203	0.010760326
Variance	34.34982503	58.66743105
Observations	34	34
Pearson Correlation	–0.111508938	
Hypothesized Mean Difference	0	
Df	33	
t - Stat	0.048385013	
P (*T*< = *t*) one-tail	0.48085053	
t Critical one-tail	1.692360309	
P (*T* < = *t*) two-tail	0.961701059	
t Critical two-tail	2.034515297	

Table 3. ***t-Test Result Table for T– 5 and T+5 Timeframe***

t-Test : Paired Two Sample for Means		
	***T* – 5**	***T* + 5**
Mean	0.886821746	0.128380549
Variance	9.653034074	14.12364185
Observations	34	34
Pearson Correlation	–0.165324952	
Hypothesized Mean Difference	0	
Df	33	
t - Stat	0.841225519	
P (*T* < = *t*) one-tail	0.203138148	
t Critical one-tail	1.692360309	
P (*T* < = *t*) two-tail	0.406276295	
t Critical two-tail	2.034515297	

Table 4. ***t -Test Result Table for T– 1 and T+1 Timeframe***

t - Test: Paired Two Sample for Means		
	***T* – 1**	***T* + 1**
Mean	0.291664775	0.089565993
Variance	3.785098085	7.118642083
Observations	34	34
Pearson Correlation	0.175406144	
Hypothesized Mean Difference	0	
Df	33	
t - Stat	0.391016342	
P (*T* < = *t*) one-tail	0.349149181	
t Critical one-tail	1.692360309	
P (T < = *t*) two-tail	0.698298361	
t - Critical two-tail	2.034515297	

As observed in Table 3, the *p*-value is greater than 0.05, and thus, we cannot reject the null hypothesis of the one-tailed paired *t*-test.

As observed in Table 4, the *p*-value is greater than 0.05, and thus, we cannot reject the null hypothesis of the one-tailed paired *t*-test.

As seen from the above results for all the four timeframes, the *p*-value is greater than 0.05, and thus, we cannot reject the null hypothesis H01. Thus, we cannot certainly say that there is wealth creation for the acquiring company's shareholders after the M&A deal. This is also supported by literature wherein Raghuvanshi and Raghuvanshi (2014) said that abnormal returns are enjoyed by the target company rather than the acquiring company due to the premium they pay for the deal.

Results of Neural Network

A neural network helps us address the second hypothesis and understand the impact on firm performance and synergy gains, if any, obtained through M&A deals. A neural network is a type of algorithm that tries to discover the underlying relationships between various factors in given data. It tries to mimic the way the human brain works. An artificial neural network is widely used in today's financial world for various activities like forecasting, predicting share prices, etc. Similarly, a neural network is used to predict the values of the deals in our M&A dataset (Figure 4).

Figure 4. ***Diagrammatic Representation of Neural Network***

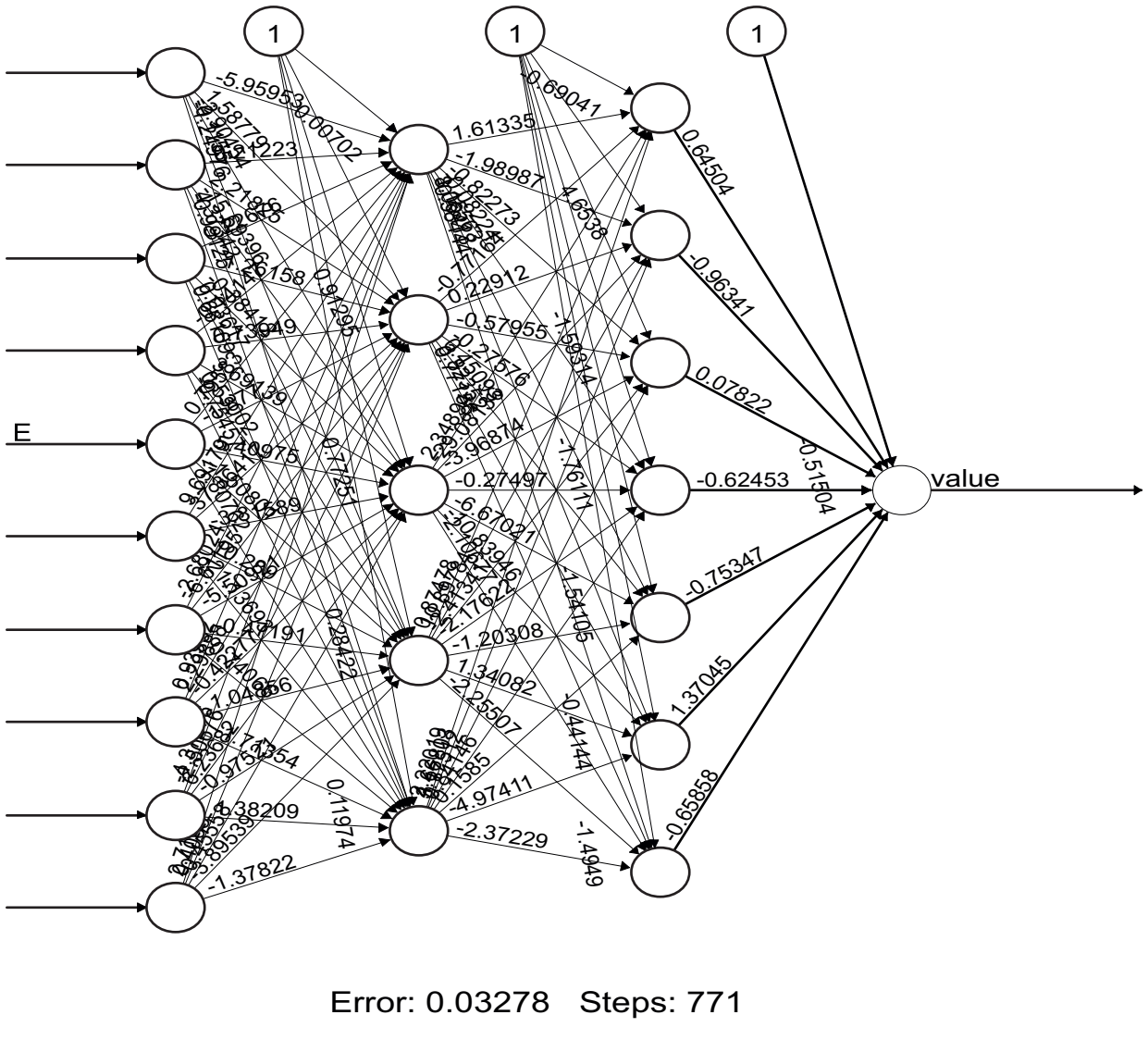


Table 5. ***Neural Network - Predicted vs Observed Values***

Predicted	Observed
0.158447	0.0013
0.146272	0.0189
0.1573	0.6501
0.15142	0.3213
0.171035	0.0248

The dataset was scaled first, as scaled data is recommended when working with deep learning models. The dataset was then split into a 7 : 3 ratio, where 70% of the dataset was used to train the model, and the other 30% was used for testing the model. Backpropagation was used to fine-tune the weights so that the model obtains as low an error rate as possible and the model is linear too. A total of 771 steps were needed to arrive at the model, two hidden layers consisting of five nodes in the first layer and then seven nodes in the second were obtained. The RMSE of the model is 0.032.

The model is then used to compute or predict the values of the valuation of the deal. The RMSE for the training set is around 0.229, and for the testing set, it is around 0.258. Willmott et al. (1985) and Willmott and Matsuura (2005) reported that RMSE values between 0.2 and 0.5 showed that the model could relatively predict the data accurately; hence, they are deemed acceptable in the current context. The error rate can further be reduced by taking a large dataset which can help train the model better in predicting values with low error rates.

The predicted and observed values (Table 5) show a significant difference. Also, in some cases, the observed value is higher than predicted. One of the reasons for it, in our opinion, is that valuation depends on the type of the deal and the target company. The cases where observed values are higher than the predicted values are where the actual deal value is among the highest. A more prominent target was acquired than the other deals where a smaller target or a portfolio of drugs was acquired. Generally, the companies overpay for deals involving larger targets as they estimate higher synergistic gains than the smaller target deals, where estimation may not be higher, or gains are seen in the short run. The rationale behind this is that when pharma companies engage in M&As to buy capacity or a currently selling portfolio of drugs, it is possible to estimate the correct price using various methods available. However, when they buy a firm for a portfolio of drugs that are still under testing or will be available only in the future, the firms may not be able to calculate the price due to the many uncertainties involved accurately. Thus, based on the above discussion, it can be concluded that we fail to accept the null hypothesis H02. Firms generally overestimate the synergistic gains and end up paying a premium in M&A deals.

Conclusion

The paper aims to understand :

- The M&A activities.
- Influencers that contribute to the M&A activities.
- Any synergy created through M&As (especially in the Indian pharmaceutical industry).

The price generally paid by the acquiring company reflects the synergistic gains. Thus, the objective is to understand if the companies correctly measured that synergy and also to understand how synergy can be calculated eventually. The synergy in the pharmaceutical industry is perceived in the form of cost savings,

increased sales, etc. Thus, the synergy should be reflected in the changes in the financial ratios. Hence, the change in the financial ratios is used as an independent variable to predict the deal's value, which is the dependent variable. An artificial neural network model is built for the same. The RMSE obtained by the model is around 22%. RMSE values between 0.2 and 0.5 show that the model can relatively predict the data accurately.

Pharmaceutical M&As can take place for various reasons. One of the popular reasons is acquiring newer drugs or a new pipeline of drugs or technology. As these drugs are still under development, their impact can only be understood after a few years of their launch or the M&A deal. Thus, pharmaceutical companies generally pay a premium for such deals; whereas, for other reasons, like acquiring a currently sold product or manufacturing facilities, the impact can be seen in the short term. Thus, a company can accurately value the synergies in such deals and may not pay a premium for such deals. It is also seen in our model, where companies paid a premium for bigger deals and paid less than the premium for smaller companies. This model can be considered a good starting point to value synergy. However, to make this model robust, more data is required. Thus, to address the first hypothesis, an event study of CAR was done based on four timeframes. The result is in line with what is seen in the literature wherein Ranju and Mallikarjunappa (2017) stated that the acquiring company's shareholders do not enjoy the abnormal returns.

The study helps us understand the Indian pharmaceutical industry and the motivations behind M&A activities, along with how the synergy is calculated or perceived by the acquiring company. As this industry looks at long-term solutions through M&As, the synergistic gains may not be realized in the initial years or in the short term. The synergy also depends on the type of deal and the acquired target company. The model developed in the paper can also be looked at to predict the deal's value.

Managerial and Theoretical Implications

As the world moves towards a more digital and data-driven society, the adoption of machine learning has been one of the core tenants. AI/ML methods are replacing traditional methods, and this study aimed to replicate the same. The prediction model is an additional valuation tool for the pharmaceutical and investment banking industry. Traditional valuation tools like discounted cash flow method, etc., along with the prediction model, can help professionals value the companies accurately. The paper also helps the professionals identify the right set of variables to be used while performing valuation methods. The current study builds on the existing body of literature by using technologically advanced methods to value synergy in the pharmaceutical sector in the Indian context.

Earlier, valuing synergy was difficult as no method or model was available to calculate the same. This paper attempts to develop a method that can act as a starting point for professionals who intend to value synergistic gains. As the understanding of synergistic gains will improve, this method will only help develop more accurate and better methods.

The study further helps the pharmaceutical industry understand the rationale behind mergers and acquisitions whenever they intend for one. The government is bringing about policy changes in the pharmaceutical sector. As a result, studying synergy valuation in this sector can provide important implications for the managers and contribute to the existing literature. As mergers and acquisitions take place in the future, the event study will help the investors understand the impact of such an event on the share price and wealth creation, thus helping them make prudent decisions regarding their investments. The paper will also help financial and pharmaceutical industrial regulators enrich their literature and databases, thus aiding in improved decision-making during policy changes, etc.

Limitations of the Study and Scope of Further Research

The study has its limitations, which can form the basis for future research. The scale of the value of the deals led to some bias in the neural network model. As the range of value of the deals varied from a few thousand dollars to millions of dollars, this bias could not be addressed in our model. The other limitation is that the sample size of the data used was relatively small. Thus, the model could also not be fine-tuned. By obtaining and using additional relevant data in the future, the model can eventually be trained better at predicting values. Other financial ratios can also be looked at and incorporated into the model. Also, as stated, most pharmaceutical deals may be showing or will show synergistic gains in the long term. Thus, a timeframe that incorporates the long-term view can also be developed to precisely understand the deal's impact. The data for recently increased M&A activity in the Indian pharmaceutical industry was unavailable. Thus, more recent deals could not be included in the study. Also, COVID-19 is only going to lead to increased M&A activities; thus, further studies should be carried out to check the impact of COVID-19 and compare M&A deals before and after the pandemic.

CAR data of the target companies were not available, and this prevented us from comparing the gains of the target companies' shareholders vs. gains of the acquiring companies' shareholders. There are many further avenues for more research on this topic. These should be taken up accordingly.

Authors' Contribution

Dr. Chintan Gala and Dr. Mousumi Bhattacharya conceived the idea and developed a quantitative design to undertake the study. Dr. Chintan Gala obtained high-quality research papers based on the relevant keyword concepts and codes relevant to the study. Dr. Mousumi Bhattacharya verified the analytical methods and supervised the study. The numerical computations were done by Dr. Chintan Gala using software R. Dr. Chintan Gala wrote the manuscript in consultation with Dr. Mousumi Bhattacharya.

Conflict of Interest

The authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

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