

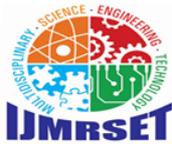
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Digital and Technology Acquisitions and Their Impact on Corporate Innovation Performance

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ABSTRACT: With the gradual expansion of China's economy, the demand for innovation and growth of China's companies is increasing. Traditional internal research and development (R&D) and iterative product and service development are no longer sufficient to meet the fierce market competition. More and more companies are seeking breakthrough growth of overall technology, brand, and service. Therefore, mergers & acquisitions (M&A) have become a common business activity for China's companies. Due to the intertwining of multiple disciplines and complex background information, the impact of M&A transaction size on the innovation performance of pharmaceutical companies has yet to be studied.

Focusing on the two hot spots: M&A and innovation, in the context of China's economic transformation and upgrading, this dissertation explores the impact of M&A on innovation based on the current situation analysis and theoretical analysis, and deeply studies and reveals the mechanism and effect of M&A transaction size on company innovation. 281 M&A data of 58 listed companies in China's healthcare industry from 2008 to 2017 was collected and regression analysis was performed to examine the impact of M&A transaction size on the innovation level of companies in terms of two aspects: the number of patent applications and the number of patents granted, and on three levels: invention patents, utility model patents and design patents. The results of the research ii show that: M&A transaction size promotes the growth of the number of patent applications and patents granted and has a significant positive effect on enterprise innovation; and M&A transaction size has contributed to the increase of the number of utility model patent applications and patents granted. In general, the innovation performance of M&A transaction size in utility model patents is better than that in invention patents with higher technological elements.

KEYWORDS: M&A transaction size; corporate innovation; absorptive capacity; pharmaceutical companies

I. INTRODUCTION

Typically, mergers and acquisitions (M&A) result in an increase in market concentration and can lead to lower levels of competition. Competition authorities, therefore, often view them with suspicion. The literature on the role of M&A on innovation is of somewhat recent origin but here again the relationship between the two is unclear. (Entezarkheir and Moshiri 2017; Szücs 2014). The present study contributes to the growing area of research on the impact of M&A on innovation among acquiring firms by analyzing data from an unbalanced panel of 217 publicly traded Indian pharmaceuticals firms. Our effort is distinct from earlier studies in three ways. One, we distinguish between the impact of mergers from that of acquisition of shares (henceforth acquisitions) and acquisition of assets (henceforth purchase of assets)1, on innovation activity. Consequently, unlike earlier studies, instead of viewing M&A as a singular strategy, we posit that mergers, acquisitions and purchase of assets can be three distinct strategies with differential impact on innovation. (Zhao, Lin, and Hao 2019). Two, recognizing that complementary assets can help firms benefit from innovation (Teece 1986) and thereby create incentives for more R&D, we examine if purchase of assets together with other M&A transactions has an impact on innovation efforts of such firms. Three, we recognize that the impact of M&A on innovative activity may take time as restructuring of R&D through M&A can be protracted in nature and take a number of years to complete (Szücs 2014). Consequently, imposing any specific lag structure on this relationship may be misleading. Instead of specific year dummies, we use the post-event dummy method to partly address this issue. We focus on the impact of M&A on innovation efforts as captured by the focal (acquiring) firm's R&D expenditures. Researchers in the past have used various measures of innovation inputs and outputs while examining the impact of M&A on innovation. Studies using innovation inputs typically use R&D expenditures (Bertrand 2009; Phillips and Zhdanov 2013; Desyllas and Hughes 2010), while those using innovation outputs utilize variables like patent counts, patent citations and new product announcements (Cloodt, Hagedoorn, and Van Kranenburg 2006; Ahuja and Katila



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2001). Szucs (2014) suggests that any of these measures can be used as there is unlikely to be a major systematic disparity between innovation inputs and outputs, especially in hi-tech sectors (Hagedoorn and Cloodt 2003). The context of the Indian pharmaceutical sector for our analysis is quite appropriate. With the implementation of a TRIPS compatible IPR regime in India, pharma industry has seen a significant improvement in the appropriability conditions. Unlike earlier when only process patents were granted, patenting of both products and processes is now possible. With the tightening of the appropriability regime, Indian pharma firms have been more actively engaged in innovation related activities (Ray and Ray 2021). The sector has also seen a lot of M&A activity in recent years (Sahu and Agarwal 2017). A better understanding of the impact of M&A on innovation activity in the changed institutional context would be quite useful for the policy makers. The study (Nagesh et, al 2022). finds that acquisitions rather than mergers provide impetus to innovation activities in the acquiring firms. The purchase of assets alone does not create any substantial impact on innovation efforts unless complemented with mergers or acquisitions. Evidently, purchase of assets when combined with M&A provide access to relevant complementary assets that make R&D activity profitable. Firms seem to view purchase of assets as a strategy that is complementary to M&A strategies for enhancing innovation. The rest of the paper (Nagesh et, al 2022) is divided into five sections. The next section provides a brief review of literature to spell out a few relationships that this paper explores. Section 3 discusses the econometric model that has been estimated along with the data used for estimation. The results of various estimated models along with robustness tests undertaken by us and their results are discussed in Section 4. The final section makes some concluding observations.

II. RESEARCH GAP

Previous studies show mixed results regarding the impact of M&A on innovation. While some research suggests that mergers and acquisitions enhance innovation by providing new technologies and resources, others indicate a decline in R&D productivity due to integration challenges and organizational disruptions. Thus, there is no clear consensus on whether M&A consistently promotes innovation.

Additionally, most studies focus on developed economies like the U.S. and Europe, with limited empirical evidence from emerging economies such as India, where institutional conditions differ significantly. Moreover, prior research mainly examines short-term innovation measures like patent output, while long-term outcomes such as breakthrough innovation and sustained competitive advantage remain underexplored.

III. OBJECTIVES

The study aims to analyse the impact of mergers and acquisitions (M&A) on firms' innovation performance, measured through indicators such as R&D intensity, patent output, and product innovation. It also seeks to evaluate whether the degree of technological relatedness between acquiring and target firms influences post-M&A innovation outcomes. Furthermore, the research examines the role of post-merger integration strategies in determining the overall success of innovation after the merger or acquisition.

IV. HYPOTHESIS

H0: M&A has no significant impact on R&D intensity.

H1: Mergers and Acquisitions have a significant positive impact on firms' R&D intensity.

H0: M&A has no significant impact on patent output.

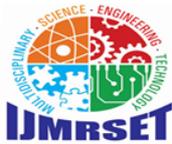
H2: Firms engaging in M&A exhibit a significant increase in patent output post-acquisition.

H0: M&A has no significant impact on product innovation.

H3: M&A activity positively influences product innovation performance after acquisition.

V. METHODOLOGY

The study adopts a quantitative research design with an explanatory and empirical approach. It is based on panel data analysis (longitudinal study), which enables comparison of firms' innovation performance before and after mergers and acquisitions (M&A). This design helps in understanding both short-term and long-term changes in innovation outcomes resulting from M&A activities.



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The research relies on secondary data collected from multiple reliable sources, including company annual reports, patent databases, financial databases such as CMIE, Bloomberg, and Capital IQ, as well as M&A transaction databases. The sample consists of listed firms that engaged in M&A during a specific period, for example from 2015 to 2023. The study may focus on industries such as high-technology, pharmaceuticals, manufacturing, or may conduct a multi-sector comparison. A control group of non-acquiring firms is also included to strengthen the analysis.

The independent variable is M&A activity, measured through a dummy variable (1 = acquisition, 0 = no acquisition), number of acquisitions, and value of acquisitions. The dependent variable, innovation performance, is measured using patent count, patent citations, R&D intensity (R&D expenditure divided by total sales), and new product introductions. Moderating variables include technological relatedness between firms, integration strategy, and whether the acquisition is cross-border or domestic. Control variables such as firm size, firm age, industry type, and market competition are included to ensure accurate results.

Data analysis techniques include descriptive statistics, correlation analysis, panel regression models (fixed effects or random effects), and the Difference-in-Differences (DiD) approach, along with robustness checks. Statistical software such as SPSS, STATA, or R can be used for analysis. The time frame covers a pre-M&A period of two to three years before acquisition and a post-M&A period of two to five years after acquisition, allowing the study to assess both immediate and long-term impacts on innovation performance.

Descriptive Statistics

Table 1

Variable	N	Mean	Standard	Standard	Min	Max	Error Dev.
<i>R&Dit</i>	1660	0.046	0.005	0.192	0.000	5.127	
<i>Mergerit</i>	4340	0.150	0.005	0.358	0.000	1.000	
<i>Acquisitionit</i>	4340	0.081	0.004	0.273	0.000	1.000	
<i>Assetsit</i>	4340	0.057	0.004	0.233	0.000	1.000	
<i>MarketShare it-1</i>	3106	0.005	0.000	0.010	0.000	0.105	
<i>FirmSize it-1</i>	3106	6.506	0.040	2.234	-2.303	11.756	
<i>LernerIndexit-1</i>	2944	0.344	0.048	2.619	-140.333	0.986	
<i>Tradeopenness it-1</i>	3106	0.232	0.005	0.269	0.000	3.000	
<i>Mergerit+1</i>	4340	0.137	0.005	0.344	0.000	1.000	
<i>Mergerit+2</i>	4340	0.124	0.005	0.329	0.000	1.000	
<i>Mergerit+3</i>	4340	0.110	0.004	0.313	0.000	1.000	
<i>Acquisitionit+1</i>	4340	0.073	0.004	0.261	0.000	1.000	
<i>Acquisitionit+2</i>	4340	0.065	0.004	0.247	0.000	1.000	
<i>Acquisitionit+3</i>	4340	0.057	0.003	0.233	0.000	1.000	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

Correlation Matrix

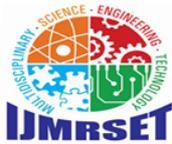
<i>R&Dit</i>	1.00
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<i>Mergerit</i>	0.04	1.00					
<i>Acquisitionit</i>	0.04	0.45	1.00				
<i>Assetsit</i>	0.04	0.26	0.28	1.00			
<i>MarketShare it-1</i>	0.06	0.28	0.38	0.29	1.00		
<i>FirmSize it-1</i>	-0.08	0.37	0.37	0.32	0.59	1.00	
<i>LernerIndexit-1</i>	-0.08	0.02	0.01	0.02	0.03	0.11	1.00
<i>Tradeopenness it-1</i>	0.03	0.14	0.21	0.19	0.23	0.31	0.02 1.00
R&Dit	(1)	(2)	(3)	(4)	(5)	(6)	
<i>M&Ait</i>							0.010*
	(0.099)						
<i>Mergerit</i>		0.001 (0.836)	0.001 (0.757)	-0.001 (0.848)	0.002	0.001 (0.868)	(0.844)
<i>Acquisitionit</i>		0.021*** (0.007)	0.021*** (0.012)	0.020*** (0.070)	0.017** (0.035)	0.018***	(0.010)
<i>MarketShare it-1</i>	0.640 (0.162)	0.516 (0.232)	0.555 (0.204)	0.513 (0.248)	0.645 (0.145)	0.513 (0.248)	
<i>FirmSize it-1</i>	-0.006 (0.385)	-0.007 (0.344)	-0.007 (0.306)	-0.007 (0.315)	-0.008 (0.274)	-0.007 (0.309)	
<i>LernerIndexit-1</i>	0.051** (0.069)	0.052** (0.058)	0.053** (0.053)	0.053** (0.053)	0.054** (0.049)	0.054** (0.051)	
<i>Tradeopenness it-1</i>	0.023 (0.127)	0.019 (0.168)	0.019 (0.170)	0.020 (0.162)	0.019 (0.191)	0.019 (0.184)	
<i>Assetsit</i>		0.008 (0.179)	-0.005 (0.449)	-0.002 (0.568)	-0.000 (0.931)		
<i>Assetsit*Mergerit</i>			0.019***				
(0.027)							
<i>Assetsit*Acquisitionit</i>					0.020***		
(0.025)							
<i>Assetsit*Mergerit*Acquisitionit</i>						0.018***	
(0.039)							
Observation	1627	1627	1627	1627	1627	1627	
F stat	2.31*** (0.001)	2.75*** (0.000)	3.32*** (0.000)	3.83*** (0.000)	4.95*** (0.000)	3.96*** (0.000)	



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R2	0.054	0.059	0.060	0.062	0.062	0.062
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 2 - M&A Activity and R&D Intensity

VI. ANALYSIS AND INTERPRETATION

Descriptive Statistics Analysis

The descriptive statistics provide insights into the distribution, variability, and characteristics of the key variables used in the study.

- **R&D Intensity (R&D it)** Mean = 0.046, Standard Deviation = 0.192 & Max = 5.127

The average R&D intensity is relatively low (4.6%), indicating that most firms invest modestly in research and development. However, the high maximum value (5.127) and relatively large standard deviation suggest strong heterogeneity — a few firms invest heavily in R&D. This variation supports the suitability of using panel regression techniques to capture firm-level differences.

- **Merger Activity (Merger it)** Mean = 0.150, Dummy variable (0 or 1)

Approximately 15% of firm-year observations involve mergers, indicating that merger activity is present but not dominant in the sample. The declining means in: Merger_it+1 = 0.137, Merger_it+2 = 0.124 & Merger_it+3 = 0.110 suggest that merger occurrences reduce over time, or firms do not frequently engage in consecutive mergers.

The mean value of the acquisition variable ($Acquisition_{it}$) is 0.081, indicating that only 8.1% of the observations involve acquisitions. This suggests acquisitions are relatively less frequent compared to mergers within the dataset. The declining pattern observed across future years (t+1 to t+3) further indicates limited repeated acquisition behavior and may reflect a postacquisition consolidation period, during which firms focus on integration rather than pursuing additional deals.

Regarding firm characteristics, the mean value of assets ($Assets_{it}$) is 0.057, indicating moderate asset concentration within the sample. The lagged market share has a mean of 0.005, suggesting that firms, on average, hold relatively small market shares, which reflects a competitive industry structure. The lagged firm size shows a mean of 6.506 with a relatively high standard deviation of 2.234, highlighting substantial variation between small and large firms in the dataset. The lagged Lerner Index has a mean of 0.344, indicating moderate market power on average; however, the minimum value of -140.333 suggests the presence of extreme outliers or possible data irregularities, which may require winsorization. Lastly, the lagged trade openness variable has a mean of 0.232, suggesting that firms operate in moderately open trade environments.

Correlation Matrix Analysis

The correlation matrix helps identify relationships between variables and detect potential multi collinearity.

- **Relationship Between M&A and Innovation**

R&D and Merger = 0.04, R&D and Acquisition = 0.04 These are positive but very weak correlations, suggesting:

- Immediate simple correlation between M&A and R&D is minimal.
- Innovation effects may appear only after time lags.
- Multivariate regression analysis is necessary.

- **Merger and Acquisition Correlation** - Correlation = 0.45 This is moderate but below critical multicollinearity thresholds (0.7–0.8). Thus, both variables can be included in regression models.

- **Firm Size and Market Share** - Firm Size & Market Share = 0.59 (Moderately high correlation but still acceptable). Larger firms tend to have higher market share.

- **Firm Size and R&D** - Correlation = -0.08 Negative but weak. This suggests larger firms in the sample may not necessarily spend more on R&D proportionally.



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- **Lerner Index and R&D** -Correlation = -0.08 Weak negative relationship indicates that firms with higher market power may not necessarily invest more in innovation in this dataset.
- **Trade Openness and R&D** -Correlation = 0.03 Very weak positive relationship. Trade exposure alone may not directly drive R&D intensity.
- **Multi collinearity Assessment**- No correlation exceeds 0.70, Highest is 0.59 (Firm Size & Market Share) Therefore: Multi collinearity does not appear to be a major concern. However, VIF testing is recommended in regression analysis.

VII. KEY INSIGHTS FOR THE STUDY

The findings suggest that M&A activities show a weak direct correlation with R&D, indicating that acquisitions or mergers alone may not automatically enhance innovation performance. Instead, innovation outcomes appear to depend on several contextual factors, such as the effectiveness of post-merger integration, specific firm characteristics, and the overall market structure in which firms operate. The results also highlight significant heterogeneity among firms, suggesting that the impact of M&A on innovation varies considerably depending on firm specific and industry-related factors.

Implication for Hypothesis Testing

The weak correlations suggest:

- H1 (M&A → Innovation) requires regression with control variables.
- H2 (Technological relatedness) may act as a moderator.
- H3 (Integration strategy) likely plays a mediating role.

Simple correlation does not capture causal effects.

VIII. CONCLUSION

Mergers and acquisitions are often combined together when their impact on innovation is analysed. Implicitly, therefore, the two are seen as substitute strategies, which are likely to have similar impact. However, our study suggests that the effect of the two can be different with acquisitions resulting in higher innovation effort while mergers do not have a significant impact. We also show that it is useful to consider the role of purchase of assets in mediating the relationship between M&A and innovation. Our results show that while, asset acquisition does not have a significant impact on innovation independently, when combined with M&A activity, it has a positive impact on the innovation efforts of the acquiring firm. Purchase of assets when combined with acquisitions or mergers has a positive effect on the R&D intensity. While acquisitions have an independent positive effect as well, in the case of mergers the effect is positive and significant when mergers are combined with purchase of assets. Evidently, purchase of assets enhances the possibility of acquiring firm profiting from innovation when it engages in merger or acquisitions activity. Presumably, the purchased assets work as critical complementary assets that help acquiring firm to leverage the combined knowledge bases of the merged or acquired entities and introduce innovations profitably. This results in higher innovation effort post the M&A activity as the efficiency of R&D efforts improves with the complementarity of various knowledge and other assets (Bertrand 2009). Mergers and acquisitions typically dealt with under a common regulatory scheme, but our results show that effects on innovation can be quite different. This paper contributes to the literature in a variety of ways. We bring out the value of distinguishing between mergers, acquisition of shares and acquisition of assets while analyzing the impact of M&A activity on innovation. In the process we also highlight the role of complementary assets that can help firms benefit from innovation and thereby create incentives for more R&D post the M&A event. For example, several features of M&A activity (e.g., horizontal vs. vertical vs. conglomerate; technology vs. non-technology; domestic vs. cross-border) are likely to affect this relationship. Similarly, many firm characteristics (e.g., absorptive capacity, knowledge base) of the acquiring and the target firms can moderate this relationship. Studies that use innovation output like patents or number of product or process innovations as measure would also face similar problems. But we hope that as more data becomes available, our incremental effort can be extended to derive more insights.



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IX. SCOPE FOR FURTHER RESEARCH

Future research can expand the understanding of M&A and innovation by focusing on emerging economy perspectives. Most empirical studies are concentrated on developed markets such as the U.S. and Europe, leaving a gap in evidence from emerging economies like India, Brazil, and Southeast Asia. Since institutional frameworks, regulatory environments, and capital market conditions differ significantly in these regions, examining how these factors influence M&A-driven innovation outcomes would provide deeper and more context-specific insights.

Another important direction for future research is the growing trend of digital and AI-driven acquisitions. With rapid digital transformation, firms are increasingly acquiring technology startups to gain capabilities in artificial intelligence, fintech, data analytics, and platform-based business models.

Additionally, there is a need to examine the long-term innovation impact of M&A activities. While many existing studies focus on short-term outcomes such as patent output within one to three years after acquisition, innovation is a long-term strategic process. Future research can analyse longer time horizons, such as five to ten years' post-acquisition, to determine whether M&A leads to sustainable innovation and competitive advantage or merely provides temporary improvements in innovative output.

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