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Post-M&A Innovation in Indian firms – An Empirical Investigation

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ABSTRACT

A large number of studies have examined the antecedents of post-M&A performance especially in the case of cross-border acquisitions. However the literature on post-M&A innovation is very limited. Furthermore, not many studies examining M&As in the Indian context have been published in leading journals. We try to fill this gap by conducting an empirical study on post-M&A innovation. We analyzed a sample of 85 domestic M&As by Indian firms during the period between 2000 and 2015. We found a positive relationship between relative absorptive capacity of the acquirer and post-M&A innovation performance. Size of the firm positively moderated the relationship between relative absorptive capacity and post-merger innovation performance. The M&A activities between firms in the same industry increased post-merger innovation performance.

INTRODUCTION

In mergers and acquisitions, independent firms with their own governance structure combine their operation into a single new entity(de Man & Duysters, 2005), by allowing the acquiring firms to change its resources, routines, and structures(Choi & McNamara, 2018). Traditionally M&A (Mergers and Acquisitions) has motives like market entry, growth of the firm, improved efficiency, and reduction of risk by diversification(Hitt, Hoskisson, & Harrison, 1991). In today's radically changing economy M&A have focused on absorbing complementary external technology to compete successfully(de Man & Duysters, 2005). Acquisition of external knowledge as a substitute for internal knowledge development has become an important motive of M&A due to rapid technological changes (Chakrabarti et al., 1994). Time compression diseconomies of internal innovation make the technological acquisition a popular strategy(Sears, 2018). Firms rely more on external knowledge sourcing due to the high complexity of internal innovation(Cefis & Marsili, 2015). Firms have used various mode to access external knowledge such as licensing, company acquisition, R&D outsourcing, Researchers hiring(Cockburn & Henderson, 2003).M&A is preferred for transfer of knowledge between the acquirer and target firms when other collaboration modes of knowledge are not successful(Lehto & Lehtoranta, 2006). M&A has been an attractive mode for technology diversification and strengthening existing competencies(Hussinger, 2010a), by filling the gaps in existing technology lines and using assets and capabilities of the acquired firm(Ahuja & Katila, 2001; Cassiman & Veugelers, 2006; Cloudt, Hagedoorn, & Van Kranenburg, 2006). M&A allows firms with complementary knowledge to combine their specific strengths and develop new products and technologies which were not possible for individual firms. As per industrial organization literature M&A avail the

economies of scale and scope and eliminate the duplication of effort for the same research(Szücs, 2014).

There are not many studies focusing on M&A and innovation(de Man & Duysters, 2005). Major research on technology acquisition has been done in developed countries; developing countries are less focused(Sun, 2014). Impact of absorptive capacity of both acquirer and target on post-merger innovation performance is not studied. Impact of firm relatedness on the post-merger innovation performance is also not clear. External technology acquisition by M&A requires reconfiguration of firms internal R&D(Grimpe, 2007), and coordination between organizational units for commercialization of inventions(Puranam, Singh, & Zollo, 2006). The acquisition has used as a dominant growth strategy but the role of M&A on innovation performance is not clear(Datta & Roumani, 2015). Performance of the firm in technology acquisition is not studied much. Firm performance in technology acquisition depends on the ability of the firm to convert external knowledge into commercial products and services (Datta & Roumani, 2015).It is very important to study the impact of mergers and acquisition on innovation due to at least two perspectives (Ahuja & Katila, 2001). First, it helps in understanding the process of organizational learning, innovation. It also helps in understanding the process of using and absorbing external knowledge by acquirer firms and how absorptive capacity of firms affect post-merger innovation performance. Second, it helps in understanding how the relationship between acquirer and target knowledge influence the post-merger innovation performance.

In this study, we empirically investigate the impact of M&A on post-merger innovation performance. We have measured post-merger innovation performance as R&D intensity after three years of the merger. We find that high relative absorptive capacity of the acquirer increase

the post-merger R&D intensity of the firm. Size of the firm plays a positive moderating role between relative absorptive capacity and post-merger innovation performance. Merging firm from the same industry has high post-merger R&D intensity. We contribute to the limited literature of M&A and Innovation in developing countries context. Limitation of our study is that we have only domestic merger transactions and not considered differential industrial effect.

In this paper, we further discuss M&A and innovation literature followed by hypothesis development. Data and methodology section explain the sample selection, characteristics of data, variables description, the method used for econometric analysis. In the last sections, we have discussed results from econometric analysis and conclusions.

LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

M&A has been a popular strategy of firm expansion(Shimizu, Hitt, Vaidyanath, & Pisano, 2004). Firms go through acquisition for vertical integration, mimic rival firm acquisitions, acquiring talent pool and knowledge. Acquisitions allow for access to developed organizational networks, technological know-how, managerial skills, and other valuable assets(Anderson, Sutherland, & Severe, 2015). From a knowledge-based perspective, the acquisition is the absorption of acquired firm knowledge into acquiring firm knowledge(Ahuja & Katila, 2001). (Nguyen, Yung, & Sun, 2012) investigated a sample of 3520 united states domestic acquisition and found that 73% transaction is to respond market timing, 59% are having motives of agency and managerial hubris, 3% are caused by economic and industry shock and about 80% are having multiple motives. (Trautwein, 1990) has explained the theoretical perspective from literature to explain the motives of M&A(see Table:1)

Insert Table 1 about here

The acquisition enables firms to enrich innovation and allow for accessing external knowledge which is not possible to develop internally or time-consuming(Prabhu, Chandy, & Ellis, 2005). Developing and gaining technical capabilities are becoming important motives for acquisitions(Shin, Han, Marhold, & Kang, 2017) because some capabilities cannot be developed by firms individually or collaboration enables to develop faster by merging the best practices of the firms(de Man & Duysters, 2005). This also improves the productivity of the research and development (R&D) expenses.

Ahuja & Katila, 2001, defined technological acquisition as inputs for acquirer firm to broaden its knowledge base and proving economies of scale and scope by recombination of resources. While acquisition which is not primarily motivated by technology acquisition are having a less likely effect on innovation outputs(Ahuja & Katila, 2001).(Conte & Vivarelli, 2014a), investigated a sample of the 3,000 Italian manufacturing companies and found that technology acquisition plays a larger role than internal R&D in the success of product innovation of firms. Technology acquisition motivated M&A performance is mediated by efficient transfer of knowledge between combining firms and smooth integration process(Cassiman & Veugelers, 2006; Cloudt et al., 2006). The innovation process of firms depends on their product portfolio diversification. Firms with the narrow product line(less diversified) likely to invest in R&D while firms with broad product portfolio (more diversified) likely to go for acquisition(Banker, Wattal, & Plehn-Dujowich, 2011). Product market competitions affect the timing of the acquisition. When the competition is low, firm invest in all expected profit making projects while when the competition

is high than the marginal cost of waiting for acquisition increases with time and firm invest in riskier projects(Barbos, 2015). Firms make a trade-off between first mover advantage and reducing the risk of investment by waiting for acquisition to get adequate information to acquire(Barbos, 2015). Empirical studies have not found any conclusive evidence of the impact of M&A on firm innovation. Some studies find a positive impact on M&A on acquirer innovation and R&D in merging firms(Ahuja & Katila, 2001; Cassiman & Veugelers, 2006; Cloudt et al., 2006) while some other studies found a negative impact of M&A on post-merger innovation(Blonigen & Taylor, 2003a; Szücs, 2014). Innovation in technology firms like IT (Information Technology) firms is influenced by market and technical uncertainty. Market uncertainty arises from unpredicted nature of future consumer preferences and technical uncertainty is related to the feasibility of the technology in the long run(Banker et al., 2011). So, innovation has a differential effect in different industries. Analyzing a panel data of German innovating firms(Grimpe & Kaiser, 2010), find an inverse u shaped the relationship between innovation performance and R&D outsourcing. So, it's evident that external R&D should complement internal knowledge for better post-acquisition performance.

Sun(2014), Investigated a sample of 108 Chinese firms of technological acquisition from 2001 to 2008 using Poisson regression and found that acquisition motivated by technology acquiring improve the innovative performance of acquiring the firm. Results also indicated that the absolute and relative size of acquired external technology impact post-acquisition innovation performance. The absolute size of acquired external technology knowledge positively impacts post-acquisition innovation performance while relative size affects negatively.

Previous research suggests that R&D intensity of a firm is negatively correlated to the likelihood of acquisition(Blonigen & Taylor, 2003b). They also found that a firm is likely to acquire another firm during its low R&D times. The productivity of R&D as providing technological and innovative assets makes a firm preferred target. (Chen, Hua, & Boateng, 2017) studied the impact of cross border M&A on innovation from the Chinese target firm’s perspective. They found that cross border acquisition increases R&D expenditure and productivity of target firms. They argued that an increase in R&D investment and productivity is due to the availability of financial and human capital. Still, the impact of M&A on innovation is ambiguous. Table: 2, present the theoretical arguments by empirical studies for the impact of M&A on innovation.

Insert Table 2 about here

Further, in the paper, we focus on the absorptive capacity of the firm, size of the firm and firrelatedness to form the hypothesis.

Absorptive Capacity and Firm Innovation after M&A

The absorptive capacity of a firm is defined as the capability to identify new and valuable external knowledge, analogize it and integrate it with existing knowledge to increase information about market trends and commercialize it(Cohen & Levinthal, 1990; Hussinger, 2010b). The absorptive capacity of the firm increases its innovation by exploiting external valuable knowledge(Cohen & Levinthal, 1990). The high absorptive capacity of a firm enables it to better exploit and integrate external and internal knowledge. It expands the firm technological

knowledge portfolio which is used for the timely introduction of new products and service due to better innovation capabilities(Datta & Roumani, 2015). Previous studies found that target firms with high R&D investments not only add to acquirer pipeline of innovation but they also independently add process and product development to improve the firm portfolio(Yu, Umashankar, & Rao, 2016).(Cohen & Levinthal, 1989, 1990), argued that acquisition of external technologies improves the firm knowledge base and technological portfolio which also improves a firm's ability to utilize and absorb external knowledge. External knowledge is generally tacit in nature of developing firm and extent of exploitation by acquiring firm is dependent on the absorptive capacity of the firm(Anderson et al., 2015). Merger benefits the acquiring firm not by a transfer of wealth in the form of customer s and suppliers but they benefit the firm by increasing the utilization of the resources(Sonenshine, 2011). Resource utilization of the firm is dependent on the absorptive capacity of the firm. In the merger, the target firm is absorbed by the acquiring firm by integrating the R&D and other operational departments. Investment in R&D improves the absorptive capacity of a firm to create new knowledge(Banker et al., 2011). We argue that firms with relative high R&D investment are having a high absorptive capacity that improves the firm post-acquisition innovation performance. The stock of prior knowledge dependent on firm investment in R&D which enables the firm to effective scanning and screening of potential target and absorption of external knowledge(Cassiman & Veugelers, 2006). Technical form of knowledge is best known by the researcher do it is difficult to absorb by the acquirer. Acquirer with the appropriate level of internal technical competences will be successfully able to value and integrate the target knowledge(Hussinger, 2010b). It implies that a certain level of investment and accumulation of R&D is necessary for the acquirer to have better post-merger innovation performance. Acquirer with relative high R&D intensity than the target

will have a high absorptive capacity to integrate and commercialize the acquired knowledge base. We argue that acquirer with high relative absorptive capacity than acquirer will have a high incentive to invest in R&D to realize the potential technology base and have better innovation outputs.

Hypothesis 1. Acquirer firms higher relative absorptive capacity than target firms is positively associated with post-merger innovation performance in the long run (three-year post-merger).

Size of Firm and Post-merger Innovation

Size of a firm is important to form the perspective of human integration after M&A. (Cefis & Marsili, 2015), find that firm size distribution affect the firm's probability to invest in innovation and continue with innovation after mergers and acquisitions. (Conte & Vivarelli, 2014b), argued that larger firms have better incentive to invest in R&D. Size of the firm is a crucial dimension to impact the investment in R&D and technology across the different types of firms. Small and large firms have different incentives to invest in R&D. Firms with large size can access innovation by acquiring small innovative firms while small firms can have higher R&D investments to get acquired by large firms at a high premium (Phillips & Zhdanov, 2013). It is not profitable for large firms to invest in R&D when the market demand is low, it's better to acquire small innovative firms at low demand (Phillips & Zhdanov, 2013). Larger firms are more required to fill the gaps in their R&D by acquisition for economic success while small and younger firms with a low market share can invest more in R&D (Ranft & Lord, 2002). Studying a sample of Dutch Manufacturing firms, (Cefis & Marsili, 2015) found that for small firms it's very difficult to cope up with higher uncertainties of M&A and innovation. Small firms can avoid investing in R&D after M&A due to various challenges of R&D personal hiring and high

cost of establishing R&D facilities. Small firms find it difficult to follow a continuous innovation strategy due to capability and resource constraints, they choose to acquire or buy rather than investing in innovation(Cassiman & Veugelers, 2006). Larger firms build their existing competencies and knowledge base by incremental innovation. Larger firms have strong market power with better knowledge of imperfect competitive knowledge. They have the incentive to make higher R&D investments by expecting long terms pay-offs(Wagner & Hansen, 2005). We argue that firm size moderate the relation between a firm's absorptive capacity and post-M&A R&D intensity.

Hypothesis 2. Positive association between relative absorptive capacity and post-merger innovation is strengthened with increasing size of acquirer.

Firm Relatedness and Innovation

In innovation firm relatedness can be defined in term of technology similarity and complementarity. Technology similarity between firms is defined as the degree of focusing in the same area of knowledge for solving technical problems. Technology complementarity between firms is defined as the degree of focusing on different restricted areas within the same broadly defined area for technical problem solving(Makri, Hitt, & Lane, 2009). Firm's decision to enter into the new technological area by acquisition is supported by the reduction of firms risk by technology diversification(Hussinger, 2010a). At the same time, firms can decide to enter into a similar technology area by the acquisition of firms with developing the new technology and product in the same area. It will reduce the competition and improve future growth perspective(de Man & Duysters, 2005). Makri et al 2009, examined a sample of chemical, drug and electronics firms and find that complementarity of technological and scientific knowledge

enhance novelty and quality of post-merger innovation. They suggested that acquiring firm should look for a target with complementary technological and scientific knowledge. A moderate level of overlap between acquirer and target knowledge has a positive impact on post-merger innovation performance. Firms with high knowledge similarity and high knowledge unrelatedness have low post-merger innovation performance (Makri et al., 2009). (Shin et al., 2017), investigated a sample of 187 Biopharmaceutical industries having 412 M&A deals and found that complementarity and similarity of acquired firm knowledge with acquirer firm's knowledge where the acquirer is having expertise have no advantage for post-merger innovation performance. The similarity of target firm knowledge with acquirer knowledge has a positive impact on post-merger acquirer innovation performance where the acquirer has not enough expertise. They have also argued that Complementarity of acquirer and target knowledge base in the new core area where the acquirer is not having any expertise have a positive impact on post-merger innovation performance of acquirer.

Hussinger (2010a), empirically investigated a sample of German domestic M&A and find that acquisition of related technology SMEs strengthens the technological competencies of the acquirer. The acquirer has an information advantage while target with related technological knowledge is acquired. The merger between related technological portfolio firms is beneficial for maximum realization of complementary knowledge while too much similarity reduces to the scope of mutual learning (Ahuja & Katila, 2001; Cloudt et al., 2006). Lee & Kim, n.d., analyzed the effect of firm size on innovation acquisition in high tech industries and find that large firm with lower technology similarity have better most merger innovation performance while a high level of product market relatedness has a negative impact on post-merger innovation performance. They also found that small firms with high product market relatedness have better

post-merger innovation performance in contrast to lower technology relatedness. So a medium level of similarity between merging firm's knowledge is required for better post-merger innovation performance of the acquiring firm. We argue that industry relatedness between firms have a positive impact on post-merger innovation performance of the firms because it will provide the scope of mutual learning with reduced product market competitions. This incentivize firm to invest in R&D and improve post-merger R&D inputs.

Hypothesis 3. Industry relatedness between merging firms have a positive impact on post-merger innovation of the firm in the long run(three-year post-merger).

We have given an overall theoretical model to show all the relationships in the figure: 1.

Insert Figure 1 about here

DATA AND METHODOLOGY

Data Specifications and Summary Statistics

Data of Indian firms is taken from Prowess-IQ database by CMIE (Center of Monitoring of Indian Economy). Merger from 2000 to 2015 are taken in the sample. Sample firms are filtered as:

1. The company listed in BSE Exchange are taken

2. Only merger deals with complete status are taken
3. Acquirer firms without reporting three years pre and post-merger R&D investment are omitted from the sample
4. Deals with the only domestic target are taken

Initially found 1599 completed mergers deal of Indian firms from 2000 to 2015. After removing the firms which have not reported the R&D data, the final sample has 85 number of merger transaction by 56 acquirers. Figure: 2, is showing the year wise distribution of firms in the sample. The final sample has a high number of merger transactions from the initial four and last four years.

Insert Figure2 about here

Table: 3, is showing major summary statistics of the variables used in the study. R&D growth of the acquirer is having a positive value with high variance. Most of the acquirer and target firms are publicly trading. The acquirer is having higher pre-merger R&D intensity than the target for about 86 percent of firms. About 57 percent of firms involved in the merger transaction are related firms with the same 2-digit NIC (National Industrial Classifications) code. Size of the acquirer measured as total asset value is having very high variance. Age of firms is also having high variance with a minimum of 7 years to maximum 77 years. Mean value of post-merger ROA (return of asset) is lower than premerger ROA. Mean value of leverage ratio (Debt/Equity) is near to 1, with high variance.

Insert Table 3 about here

Variables and Measurement

Dependent Variable We have measured the effect of mergers on innovation activities as the innovation input dimension. We have taken one measure of innovation input as the R&D intensity of the firm three years after the merger (Ornaghi, 2009; Szücs, 2014). Previous studies suggest that there is a high correlation between innovation output (patent frequency) and innovation input (R&D expenditure) that one of these can be used to measure innovativeness of the firm (Ahuja & Katila, 2001; Cloudt et al., 2006). R&D inputs and outputs are having a high correlation and there is no systematic discrimination between these two measures of innovation (Hagedoorn & Cloudt, 2003). R&D input expresses the firm's willingness to invest in innovation for long term success (Szücs, 2014). R&D intensity is measured as the ratio of R&D expenditure to net sales of the acquirer. Previous studies suggest that the effect of mergers on innovation is the same irrespective of 3 or 5 –years after the merger (de Man & Duysters, 2005). We have taken three-year post-merger R&D intensity to measure the innovation performance.

Independent Variables We have used three independent variables as relative absorptive capacity of the firms, size of the firm and firm relatedness. The absorptive capacity of a firm is based on its accumulated knowledge base, technology resource level, and R&D intensity level (Hitt & Kim, 1997). R&D intensity of the firm is measured as the ratio of R&D expenditure to sales (Hitt, Hoskisson, & Harrison, 1991). Relative absorptive capacity is measured as a difference in

acquirer and target premerger R&D intensity. Size of the firm is measured as the total asset value of the firm(Blonigen & Taylor, 2003a). The total asset value of acquirer one year before the merger is used to measure the size of the firm(Choi & McNamara, 2018). Size of the firm is used as the moderator between relative absorptive capacity and innovation performance of the firm. Firm relatedness of the firm is measured by the similarity of two-digit SIC(Standard Industrial Classification) code in previous studies done in developed countries(Hitt et al, 1991,Frenken et al2007). We have considered only Indian firms merger transaction and relatedness of firms is measured on the basis of similarity of 2-digit NIC (National Industrial Classification) code.

Control variablesWe have used the age of the firm, ROA, firm's public status, a Leverage ratio of the acquirer, year dummies as control variables. Age of the firm is measured at the time of the merger in the number of the year since the firm establishment(Le, Park, & Kroll, 2014; Zhang, Deng, & Tang, 2019). Previous studies show that firms initially show a high level of innovation activities and that reduces as the age of the firm increases(Huergo & Jaumandreu, 2004). The older firm has high experience to invest in R&D for better outputs but at the same time, they have high sunk cost prior R&D projects which will reduce the propensity to invest in R&D(Zhang et al., 2019). The leverage ratio of the firms is measured as debt to equity ratio year prior to the merger. Pre and post-Merger ROA are also used as a control variable(Hitt et al., 1991; Makri et al., 2009). Premerger ROA is the three year average of prior to merger while Post-merger ROA is the three year average of after merger. Year dummies is a binary variable(Le et al., 2014). It is denoted as 1 for the year of acquisition, otherwise 0. We have summarized the variable measurement in the table: 4.

Insert Table 4 about here

Analytical Strategy

We have used Ordinary Least Square Model (OLS) for the regression. We have used IBM SPSS.25 software for analysis. In the linear regression model, we have used the post-merger R&D intensity of the firm as the dependent variable. We have checked for normality of the scalar independent variables using the Shapiro-Wilk test. We found the age of the firm, size of the firms and leverage ratio not normally distributed. We have done the logarithmic transformation of these variables to get a normal distribution. Multicollinearity between the independent variables is checked between the independent variables using VIF (Variance Inflation Factor). We found all variables VIF values below 10 which indicate for no multicollinearity issue. First, we have used OLS to identify the linear relationship between the relative absorptive capacity of the firm and Relatedness of the firm with post-merger Innovation inputs(R&D Intensity). Then to find the moderator role of size between the relative absorptive capacity of the firms and post-merger innovation input we have used ProcessV3.3 by Andrew F. Hayes plugin in IBM SPSSV.25.

RESULTS AND DISCUSSION

The econometric results suggest that M&A influence the innovation activities of the firm. Table:5 is presenting two models of regression. In the Model:1, we have checked the linear relationship of the post-merger acquirer R&D intensity with the relative absorptive capacity and Firm relatedness. We have reported the unstandardized regression coefficients and p-value for

the variables. In the first model, we have used relative firm absorptive capacity and firm relatedness as independent variables. The leverage ratio, age of the firm, pre and post-merger ROA of the acquirer, acquirer and target public status and year dummies are used as control variables in the model:1. We find that there are a significant positive relationship between firms relative absorptive capacity and post-merger innovation inputs (R&D Intensity). Because acquirer firms with high absorptive capacity are better able to identify and use the knowledge base of target firms that incentivize to invest in R&D. The high relative absorptive capacity of the acquirer enables the knowledge sharing and positively impact the ability of the acquirer to leverage the knowledge base of the target firms (Sears, 2018). Acquirer with high absorptive can selectively use the innovation capabilities of the target (Sears, 2018). Absorptive capacity enhance exploitability of the external knowledge to improve firms post-merger innovation performance (Arvanitis, Lokshin, Mohnen, & Woerter, 2015). The relatedness of the firms is also having a significantly positive impact on the post-merger R&D intensity. We have used 2-digit SIC code for the similarity of the firms which indicates that the firms are operating in the same industries. This implies a lower degree of relatedness between the merging firms. Firms with a lower level of knowledge overlap can have better opportunities for learning from each other. The complementarity of the firms will be higher in the lower level of the relatedness which enhances the post-merger innovation performance of the firm. Because it provides a scope of utilizing the complementary resource and at the same time reduce the product market competition. Model:2 in the Table:5 is showing the moderator role of size between relative absorptive capacity and the size of the post-merger innovation inputs. Results show that the size of the acquirer plays a positive moderator role between the relative absorptive capacity of the firms and post-merger R&D intensity. There is a significant improvement in the coefficient of the relative absorptive

capacity impact on the post-merger R&D intensity. Large firms have high capability to invest in long term R&D projects and the risk-absorbing capacity is also higher.

Insert Table 5 about here

CONCLUSION

In this article, we have studied the impact of M&A on firms post-merger innovation performance. We have considered innovation input as a measure of firm innovation performance which is measured by the R&D intensity of the firm. Using a dataset of Indian firms domestic merger transaction from 2000 to 2015, we find that M&A effect the innovation performance of the firm. We contribute to the M&A and innovation literature in developing countries context. Our results suggest that relative absorptive capacity of the firm positively influence the post-merger R&D intensity of the firm. Large size firms positively moderate the positive relationship between relative absorptive capacity and post-merger innovation performance. Related firms have high tendency to invest in R&D after the acquisition. Acquisition of external knowledge provides the firm to access the technological advancements, remain flexible and reduce time compression effect of internal knowledge development(Sun, 2014).

The major limitation of our study is the small sample size due to data unavailability for firm R&D expenditures. We have only used innovation inputs to measure post-merger innovation performance. Future studies can use both innovation input and output measure of innovation performance. We have looked only on domestic merger transaction, future research can also take

cross-border acquisition. We have only considered the deal where the target is fully acquired by the acquirer. Innovation is needed to be studied at a micro-foundation level rather than a firm level.

The manager must be conscious about the picking of target firm while the motive is knowledge acquisition. The ease of integration between the merging firms will decide the post-merger benefits. The absorptive capacity and the relatedness of the firm play a very important role in the integration of knowledge. External knowledge is benefiting when the acquirer is able to identify, acquire and integrate the same. The large firm is beneficial in acquiring small innovative firm to improve its innovation performance (Ahuja & Katila, 2001).

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Table:1, Various theories and M&A Motives

Theory	M&A Motive
Efficiency theory	M&A improve Financial synergies, Operational synergies, Managerial synergies of the firm by lowering the risk of capital investment, combining the operational facilities and better decision making by skilled managers.
Monopoly theory	M&A increase the market power of the firm by reducing numbers of competitors in the sector, creating high entry barriers for new entrants and by cross-subsidizing the products.
Valuation theory	M&A is executed when the managers of the acquiring firm are having superior

	knowledge about the target firm value than the stock market
Empire-building theory	Managers execute M&A to maximize their own profit by neglecting the shareholders to get more control over the firm
Process theory	M&A is not always a rational choice but it's a type of strategic decisions which is the outcome of a process of political games between the subunits of organizations and outsiders
Raider theory	Transfer of wealth from target to acquirer firm shareholders by acquiring an undervalued firm
Disturbance theory	Economic disturbance cause uncertainty by changing the individual expectations and a merger wave cause overvaluation of assets

Table:2, Positive and negative impact of M&A on firm innovation

Positive Impact of M&A on Firm Innovation	Negative Impact of M&A on Firm Innovation
<ul style="list-style-type: none"> • M&A provides access to broader knowledge and research base and increases the scale and scope efficiencies to improve innovation productivity(Ahuja & Katila, 2001; Cassiman & Veugelers, 2006; Cloudt et al., 2006) • M&A help in efficiently reorganizing research process of firms to improve their innovation performance(Ahuja & Katila, 2001) • Increased scale economies spread the R&D fixed cost and increased scope of economies allow better leveraging of 	<ul style="list-style-type: none"> • M&A has a negative impact on firm innovation due to agency problem, less managerial commitment to innovation, managers are more focused on a complex integration process after innovation(Hitt & Hoskisson, 1996; Hitt et al.,1991) • Uncertainty about M&A outcomes cause managers to become risk averse that reduce R&D investments by eliminating riskier streams of research(Hitt et al., 1991) • Acquisition of technological firm disturb organizational routines and

<p>R&D investment due to greater diversification in M&A activities(Fernández, Triguero, & Alfaro-Cortés, 2019)</p> <ul style="list-style-type: none"> • Complementary technologies in merging firms enable reallocation of technological knowledge in diversified fields to improve firm innovation input(R&D) and output(product and process innovation)(Fernández et al., 2019) • Acquisition of technological firms increases the knowledge base of a firm that enhances the absorptive capacity of the acquiring firm to exploit external knowledge. It improves firm innovation(Ahuja & Katila, 2001) • M&A is cost-effective than strategic alliances. M&A improve innovation productivity of firm at comparative low R&D input(de Man & Duysters, 2005) 	<p>have a negative impact on innovation output of the acquiring firm(Ahuja & Katila, 2001)</p> <ul style="list-style-type: none"> • High premium paid in M&A causes financial constraint for the firm which reduces the investment in R&D activities. Firm substitute its internal R&D by externally acquired knowledge and its innovation reduced(Grimpe, 2007)
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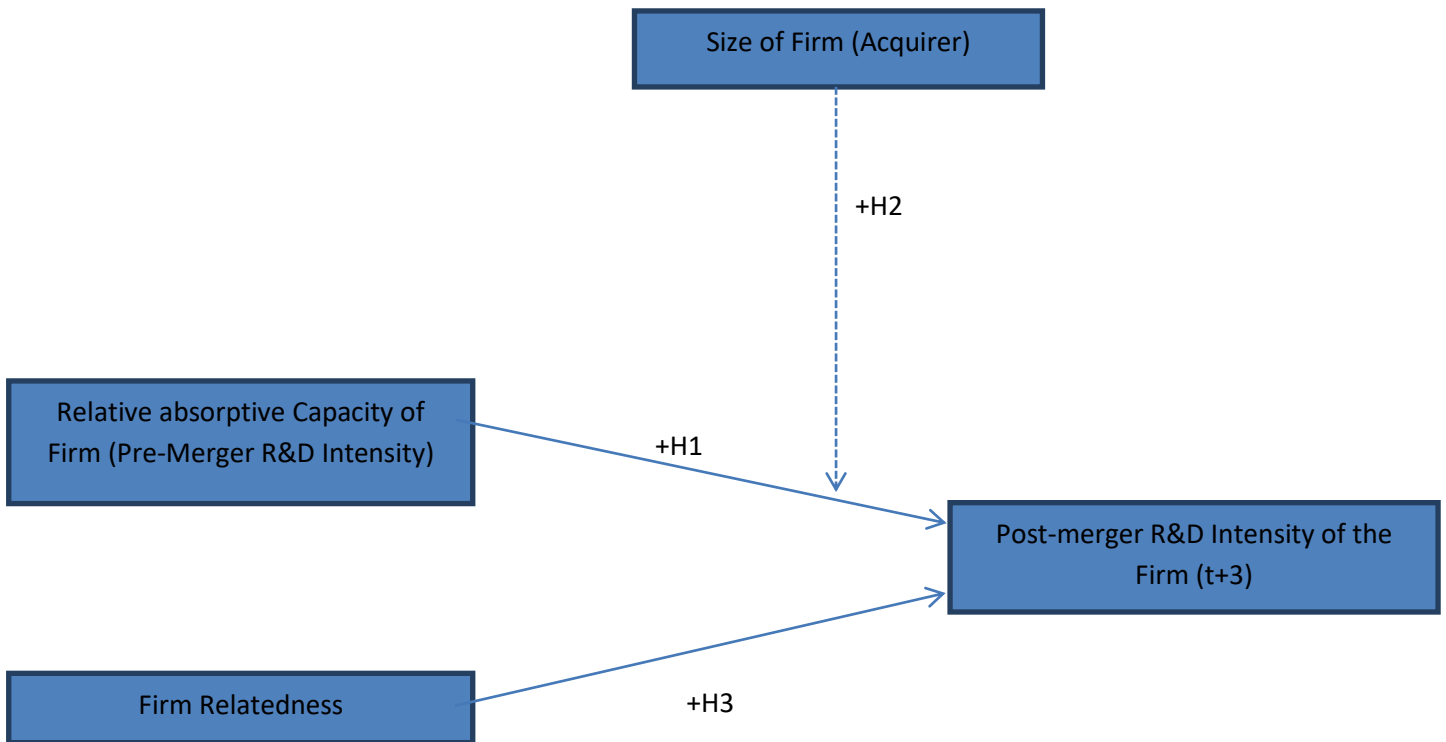


Figure:1. Impact of M&A on post-merger innovation performance of the firm: A Theoretical Framework

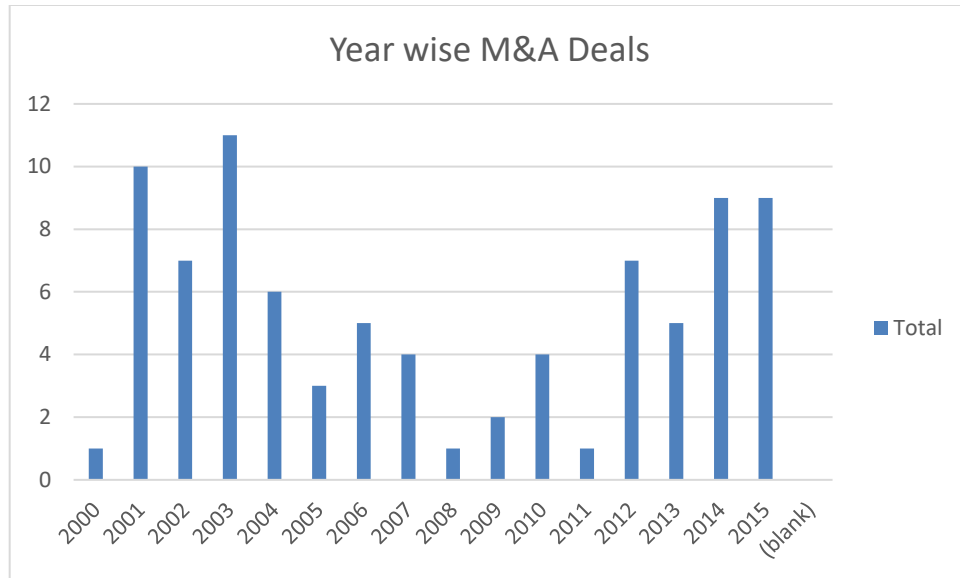


Figure:2. Year-wise distribution of firms in the sample(2000 to 2015)

Table:3, Summary statistics and correlation martix

	Mean	Std. Dev.	1	2	3	4	5	6	7	8
Rdintensity(t+3)	1.25	2.25	1							
size	30215.50	44985. 82	0.259*	1						
relativeabsorp	0.01	0.04	0.521* **	0.397** *	1					
firmrelatedness	0.53	0.50	0.0823	-0.167	-0.136	1				
leverage_ratio	0.94	0.87	- 0.0763	-0.113	-0.139	0.114	1			
age	36.45	20.57	- 0.234*	0.125	0.0839	-0.175	-0.0316	1		
preroa	5.46	9.08	0.193	0.16	-0.166	0.104	- 0.503** *	-0.202	1	
postroa	5.20	8.99	0.151	0.215*	0.0436	-0.11	-0.302**	- 0.001 8	0.444** *	1
targetpublicstats	0.92	0.28	- 0.0526	-0.236*	- 0.490** *	0.060 5	0.109	-0.109	0.132	- 0.08 3

Table:4, Variable and their Measurement

Name of Variable/Construct	Measurement	Reference
<p>Dependent Variable</p> <p>1. Post-Merger R&D Intensity of Acquirer(t+3)</p>	<p>1. Measured as the ratio of R&D expenditure to net sales (t+3)</p>	<p>Ornaghi, 2009; Szücs, 2014</p>
<p>Independent Variables</p> <p>1. Relative Absorptive Capacity</p> <p>2. Size of Firm</p> <p>3. Firm Relatedness</p>	<p>1. Measured as the difference in R&D intensity of acquirer and target(t-1)</p> <p>2. Size of Firm measured as total asset value of acquirer (t-1)</p> <p>3. Firm relatedness is the similarity of first two digitog NIC code</p>	<p>Cassiman&Veugelers, 2006</p> <p>Blonigen& Taylor, 2003a, Choi & McNamara, 2018</p>

Control Variables		
<ol style="list-style-type: none"> 1. Age of Firm 2. Premerger ROA 3. Post-merger ROA 4. Leverage Ratio 5. Year Dummies 	<ol style="list-style-type: none"> 1. Age of acquiring firm Measured in the years at the time of acquisitions 2. Average of three-year premerger ROA of the acquirer is taken 3. Average of three-year post-merger ROA of the acquirer is taken 4. The leverage ratio of the firm is measured as debt/equity ratio (t-1) 5. Year dummy is a binary variable, N-1 year dummies are taken, where N is number of the year over which sample is collected 	<p>Le, Park, & Kroll, 2014; Zhang, Deng, & Tang, 2019 Hitt et al., 1991; Makri et al., 2009</p> <p>Le et al., 2014</p>

Table: 5. OLS (Ordinary Least Square) Regression Analysis

OLS: Linear Regression Model

Dependent Variable: Acquirer R&D Intensity(t+3)

Variables	Model:1		Model: 2	
	Unstandardized B	P-value	Unstandardized B	P-value
	Coefficients		Coefficients	
Relative Absorptive Capacity	.459	.000	.9690	.0000
Firm Relatedness	.007	.084	-	-
Size of Acquirer(t-1)			.0000	.1893
Size of Acquirer*Relative Absorptive Capacity	-	-	.0000	.0436
Log(Leverage Ratio)	.003	.551	.0000	.9875
Log(Age)	-.031	.000	-.0101	.0806
Premerger ROA	.000	.560	.0003	.2248
Post-merger ROA	.001	.031	-.0002	.1842
Target Public Status	.026	.004	.0063	.3648
Acquirer Public Status	.009	.626	-.0128	.3425
Constant	.025	.371	.0311	.0895
Year Dummies Included	Yes		Yes	
No. of Observations	85		85	
R-Square	0.642		0.9113	

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