

The Effect of the Acquisition Rate on Post-Acquisition Innovation

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Abstract: Technology acquisitions are one of the most common growth strategies for firms. Firms that have made multiple acquisitions in the past are more likely to make new ones. With previous M&A experience, firms are more likely to make acquisitions. The acquisition rate is the total number of acquisitions a firm has made at a given time. In technology acquisition, the acquisition rate affects innovative firm performance. The more frequent acquisitions a firm makes, the less innovative performance will occur. A high acquisition rate negatively affects post-acquisition performance by dominating the attention of decision-makers and overloading the firm. During the process, there needs to be structural integration between the acquirer and the target firm. This study empirically analyzes 380 cases of technology acquisitions of U.S. publicly traded companies from 1990 to 2005. The results show that a high acquisition rate is negatively related to the post-acquisition innovation performance of the acquirer. Although structural integration has no impact on the negative relationship between post-acquisition performance and acquisition rate, considering the acquisition rate when pursuing M&A allows acquiring firms to avoid detrimental consequences.

Keywords: M&A; acquisition rate; structural integration

1. Introduction

Firms deploy creative ideas when innovating to create products, making it critical that they enhance their innovation capabilities. To maintain sustainable competitive advantages, they acquire resources from outside the firm. Acquiring technology is one of the most common ways to perform this [1], and they are motivated by the desire to increase their market positions by obtaining strategically valuable technologies [2]. Though time-consuming and uneconomical, firms can acquire new knowledge and technologies through internal development [3]. In the era of hyper-competition, the number of mergers and acquisitions (M&As) in knowledge-intensive and high-tech businesses has not plateaued [4], with acquisitions in both types of companies often co-occurring [5,6]. For example, in the 1990s, companies such as Cisco, General Electric, and Microsoft made more than 50 acquisitions. Rather than conducting individual transactions, they carried out a series of simultaneous and consecutive acquisitions [6].

Firms in technology-intensive businesses engage in both concurrent and serial acquisitions; however, there is sparse existing literature on the characteristics of active M&A firms and their performance after a series of active acquisitions [7–9]. Rather, previous research has focused on individual M&As and their performance and needs, complemented by studies on related post-acquisition integration behaviors. When a firm engages in an M&A, a single acquisition does not determine its performance. Therefore, it is important to examine how previous acquisitions affect subsequent ones.

Hence, this study aimed to investigate how the characteristics of the acquirer in a technology acquisition affect post-acquisition innovation performance by focusing on the following two questions: First, how does the acquisition rate affect post-acquisition innovation performance? Second, what variables moderate the relationship between the acquisition rate and post-acquisition innovation performance? We attempted to determine



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whether post-acquisition structural integration could moderate the relationship between the acquisition rate and post-acquisition innovation performance. In this regard, this study suggests that a high number of acquisitions by acquirers could negatively affect post-acquisition innovation performance. Our theoretical contribution is viewing M&A success as a process of accumulating organizational capabilities through a series of acquisitions rather than focusing on individual acquisitions per se.

Building on the attention-based view, this paper considers M&As as a process and identifies the acquisition rate, post-acquisition structural integration, and post-acquisition innovation performance as variables to understand the relationship between them. Based on previous studies, we derive research hypotheses on the effect of the acquisition rate on the post-acquisition innovation performance of firms and the moderating effect of structural integration on innovation performance. We test the hypotheses derived from the theoretical review and previous studies using a sample of 380 M&As among technology M&As of publicly traded companies from 1990 to 2005. Negative binomial regression was used to test the hypotheses.

2. Theoretical Background

2.1. Technology Acquisition

Unlike M&As, which are motivated by economies of scope and scale [1,10], technology M&As involve acquiring another firm's technology to enrich the knowledge base [1,2,11]. As part of a firm's growth strategy, the scale of M&As is decreasing, and the number of trades is becoming more frequent. For example, pharmaceutical firms regularly acquire small biotech companies to gain access to the drugs they develop. Similarly, AMD, Intel, Oracle, and Cisco regularly acquire small companies with advanced technologies [1].

Technology acquisitions that aim to secure high-tech resources must pursue post-merger integration to possess the acquired firm's knowledge and capabilities [12,13]. Thus, the knowledge transfer process is inevitable to accelerate innovation.

Mergers and acquisitions are usually driven by big motivations. They are driven by economies of scale, a race to the top in financial performance, and increased market share [14], but this study focused on technology acquisitions. Technology acquisition is a technology-focused acquisition that seeks to gain technological advantages from the target company. Technology acquisitions are completed by utilizing the acquired technology and turning it into the knowledge of the acquiring firm. The focus on technology acquisitions is to explore how structural integration to acquire technology affects a firm's innovation performance.

From an organizational perspective, the acquiring firm must integrate with the target firm to enter the market and advance its technology. At the same time, it is necessary to maintain the autonomy of the acquired firm to avoid destroying its ability to innovate [11,15,16]. Puranam et al. (2006) assert that acquirers could settle the coordination–autonomy dilemma by identifying the influence of structural integration on technological acquisitions that rely on the progress of the acquired firm's innovation paths. However, it is difficult to define the appropriate post-acquisition integration approach since it is challenging for the acquirer to accurately prejudge the progress of the acquired firm's technological innovation path immediately after the merger [16].

Moreover, the increased turnover of key managers or key R&D personnel leads to limited knowledge transfer between experts after the M&A [16,17]. Furthermore, the success of M&As can be negatively affected by employee resistance to the M&A, reflected in, for instance, passive action or proactive opposition to the deal [16,18]. Mergers and acquisitions can negatively impact the organizational structure of the acquiring company, resulting in lower productivity among the merged R&D workforce [16,19].

Despite these challenges, recombining the acquiring firm's pre-merger knowledge with new knowledge from the target is crucial to post-merger innovation. Firms must continually upgrade their knowledge base to preserve their ability to innovate [20]. Previous research has emphasized the important feature of merging knowledge from different sources for

innovation [21]. Accordingly, M&As can be considered an important source of external knowledge for promoting innovation and developing innovative capabilities [22]. M&As enable firms to integrate innovation flows into their organizations [23–25] and link the results of the acquiring firm’s creative efforts with the acquirer’s assets for production, marketing, and distribution [25–27].

However, acquisitions often fall short of their goals, the reasons for which can be traced to the nature of technology acquisitions. First, technology M&As are the acquisition of technology-based companies, requiring the acquisition and transfer of knowledge-based resources that are often tacit and socially complex [11,28,29]. Because these forms of knowledge are difficult to transfer, post-merger integration is necessary to realize the potential value [11,15,29]. However, integration ultimately destroys the knowledge-based resources of the acquiring firm through employee turnover and disrupts organizational routines [11,15].

Second, technology M&As involve acquiring the knowledge of the target firm. While tacit and socially complex knowledge is difficult for the acquirer to acquire as an outside observer, acquirers often lack information about where valuable knowledge resides in the merged organization [15,30], and buyers may make inefficient decisions.

Existing research has shown that R&D capabilities increase patent productivity, confirming that patents are the output of innovative activity and are not inherently inputs [31]. The process surrounding patents involves the formulation, systematization, and explicit expression of an innovative idea, product, or process and embodies a firm’s technical and innovative knowledge. They also represent the successful outcome of a highly uncertain research and development process. A patent application record indicates that a company has acquired procedural knowledge. Therefore, patents are an important measure of a firm’s innovation performance [16].

2.2. Acquisition Rate

The desire to acquire valuable resources, such as know-how, technology, and capabilities, from the target company has been a major motivator for recent acquisition activity [10]. Moreover, there has been a significant increase in acquisitions, especially in the high-tech sector.

The acquisition rate refers to the total number of acquisitions a firm has made in a “given time” [1,5]. It is an important characteristic that reflects the temporal distribution of a set of M&A behaviors.

Prior research has shown that the acquisition rate affects performance by influencing the acquirer’s M&A capabilities during an acquisition [5,8,18,32]. M&A capability can be defined as the development of knowledge, skills, systems, structures, and processes.

Merger and acquisition capability refers to the perceptions of the target company and to organizational skills, such as negotiating the deal and managing post-merger integration [13]. Because each acquisition requires a significant time commitment from different layers of management, many consecutive acquisitions, i.e., a high acquisition rate, lead to the critical point of organizational capacity. Managers must first decide how much effort to devote to running the existing business and how to manage the M&A process. While management capabilities can be expanded over time, acquisition-related issues must usually be addressed immediately. Some scholars believe that a high acquisition rate is rather unsuccessful contrary to what has been vaguely assumed due to the difficulties associated with post-merger integration [9].

When one firm acquires another, it must first interpret the company it has acquired. However, companies that make frequent acquisitions cannot do so quickly. The context of the firm’s knowledge is different for each acquisition, and its organizational routines are different. Thus, post-merger integration can take a lot of time and resources. Moreover, when multiple acquisitions are simultaneously processed, firms must deal with their own business and have limited time to interpret and integrate the target company. Therefore, the expected learning effect of M&As is unlikely to occur in firms with high acquisition rates.

3. Research Hypotheses

3.1. Acquisition Rate and Post-Acquisition Innovation Performance

The acquisition rate refers to the total number of M&As a firm has completed in a given time [1,5]. We expect the acquisition rate to affect the post-acquisition innovation performance. We use the concept of the acquisition rate to examine the characteristics of firms with high acquisition rates based on the attention-based view as applicable to their unique contexts.

The core of the attention-based view is that a decision-maker's attention is a valuable and scarce resource selectively allocated across the organization's activities. Hence, when a firm becomes selective, increasing the number of independent activities it handles simultaneously can cause information overload and saturate its limited attention, thereby weakening its decision-making capacity [33]. The attention of decision-makers arises from the sum of human interaction, which is historically complicated. Therefore, the decision-maker's attention cannot be diffused. Hence, the firm's everyday activities carry relatively different importance. From an attention-based perspective, companies that engage in simultaneous mergers and acquisitions are likely to experience activity overload, which negatively impacts performance.

Multiple and simultaneous acquisitions leave decision-makers less time for their daily activities due to the short intervals between past acquisitions. It is not just the volume but the lack of time to interpret and adapt information that undermines the company's ability to integrate post-acquisition knowledge. The ability of an acquiring company to integrate knowledge is increasingly weakened when it makes many acquisitions over a short period [1,34].

Even if the acquirer distinguishes between the knowledge integration opportunities derived from an acquisition and the acquisition effort when deciding whether to acquire, the acquirer will not be able to keep track of the effort after the acquisition to guide the subsequent acquisition. Acquirers should invest time and resources in identifying the knowledge and value of the target organization to ensure complementarity with existing knowledge. However, the intensity of the acquisition will result in less attention and resources being allocated to the target.

The short interval between past experiences can also lead to the mis-specification of the link between behavior and outcomes, which increases the risk of vicious circles in the learning process [35–37]. In other words, companies that have gone through multiple M&As will have their respective routines for technology acquisitions. These routines become automatic when handling the next M&A and are deeply ingrained from the firm's past deal experience. However, every M&A deal is different, and a one-size-fits-all approach to mergers and acquisitions will lead to inertia; high M&A activity reduces the ability to acquire and develop specific knowledge in the process of acquiring, distributing, interpreting, and retaining knowledge.

M&As require sufficient time to learn from the experience [5,38]. Thus, too long or too short a time interval between acquisitions affects the development of M&A capabilities [5,8]. For an infrequent acquirer, a long gap between deals can be a disadvantage as the experience of previous acquisitions becomes unavailable due to the dissolution of the teams who worked on them. However, for an active acquirer, too short a gap between deals can likewise be a disadvantage. A high acquisition rate does not allow for the time to build acquisition know-how [5,8,12,32].

Finally, as the acquisition rate increases, firms face difficult decisions about how to integrate the knowledge of multiple acquirers with their existing knowledge [3,5]. As the acquisition rate increases, the number of knowledge integration opportunities and the amount of overall knowledge increases, which also increases the risk and uncertainty of knowledge integration [1]. From this perspective, active M&A behavior should negatively impact post-acquisition innovation performance.

Hypothesis 1. *A high acquisition rate will have a negative relationship with the post-acquisition innovation performance of the acquirer.*

Existing research has adopted a learning perspective when examining firms pursuing high acquisition rates. Researchers argue that learning can enhance post-acquisition innovation performance [39] and that acquiring firms benefit from a substantial M&A experience, allowing them to integrate their knowledge with that of the target through learning. They also believe that a large volume of M&A experience improves the acquirer's ability to distinguish between valuable and complementary knowledge, as well as to develop routines for integrating knowledge [10,18]. However, it is difficult to assume that a high acquisition rate leads to learning from previous acquisition experiences, which, in turn, yields positive learning effects, as each acquisition event is fundamentally a different acquisition experience. Therefore, it does not immediately translate into good performance [40].

3.2. *The Moderating Effect of Post-Acquisition Structural Integration*

Technology M&As are the acquisition of a source of innovation, and the acquisition of a small company allows for integrating the innovation stream into the organization, aligning it with in-house assets, and using it in a coordinated way. However, integration is different from internal development. To integrate the acquired firm, the organization should not rely on existing coordination mechanisms (e.g., sharing standard operating procedures, routines, and language) [15,21,28]. Instead, post-merger coordination mechanisms should be designed and implemented, which brings us to the importance of structural integration.

In this paper, structural integration is considered to occur when a firm does not use its pre-merger name as an independent organization after the acquisition. For example, Disney acquired Pixar, but Pixar still exists independently under the Pixar name.

Structural integration, as opposed to structural separation, refers to combining previously different organizations into the same organization [41]. A "coordination effect" is achieved when structural integration is completed well. By grouping two organizational units, programming, hierarchy, and feedback coordination mechanisms can be effectively utilized to enable knowledge transfer and coordination [42–45].

Simultaneous acquisitions of different natures can make it difficult for a firm to proceed with structural integration. This challenge arises due to the following reasons. First, knowledge transfer is expected to occur through structural integration. However, if multiple acquisitions are carried out at the same time, knowledge in different contexts cannot be accurately interpreted and utilized. Second, multiple simultaneous acquisitions can lead to insufficient resources and a lack of focus on autonomy, which is the most important aspect of structural integration.

Structural integration leads to a loss of "autonomy" for the acquired firm, which reduces its ability to innovate, forcing its talent to maintain innovation activities. Therefore, the structural integration of the target company will consume more resources in the M&A process for firms with high acquisition rates. They will have to spend more time trying to achieve cooperation, creating a shared language, and solving complex integration processes. However, firms pursuing structural separation without structural integration can generate better outcomes when making frequent acquisitions, as they do not need to invest new resources and maintain the autonomy of the acquired company.

Moreover, the absence of post-acquisition structural integration can also help the CEOs of the acquiring firm relieve the overload of decision-makers in high-acquisition-rate environments and alleviate the saturation of limited attention. Graebner [46] showed that the leaders in acquired firms play a critical role in reducing the risk of integration regardless of the level of integration. The less-limited attention of acquired leaders could lead to more autonomy, and this autonomy could help achieve organizational ambidexterity. In addition, more autonomy could accelerate the exploitation of the acquired firm alongside the effort of recombining the acquiring and target firm's knowledge. Therefore, we derive the following hypotheses.

Hypothesis 2. *The absence of post-acquisition structural integration by the acquirer will positively moderate the negative relationship between a high acquisition rate and the acquirer's post-acquisition innovation performance.*

The research model of this study is presented below as a Figure 1. The acquisition rate will impact negatively to post-acquisition innovation performance of the acquiring firm and the absence of structural integration will strengthen the negative relationship of acquisition rate and post-acquisition innovation performance.

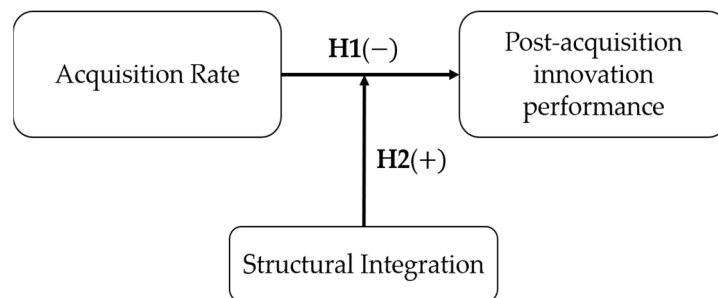


Figure 1. Research model.

4. Research Methods

4.1. Data

The sample consisted of U.S. publicly traded technology acquisitions between 1990 and 2005. We chose this sample period for several reasons. First, this period covers a wide range of economic conditions. Second, we organized the patent data by using the period ending in 2005 so that the dependent variable was a five-year window after the M&A. To construct the patent data, we combined the National Bureau of Economic Research (NBER) patent data [47] and Kogan et al.'s (2017) [48] U.S. patent data with CRSP data. Since the patent citation records are available through 2010, we used the sample up to 2005. We also ensured that both the acquiring and target firms were technology-based by having at least one patent prior to the merger.

We also obtained the SDC Platinum Database for the United States to test our hypotheses. The SDC Platinum Database provides information on mergers and acquisitions, such as the date of execution, the industry of the firm, and the size of the purchase price. The research database consists of data from the U.S. Patent and Trademark Office (USPTO) from 1976 to 2010, combining the NBER Patents and Patent Citations dataset [48] and U.S. patents matched to CRSP data [47]. The dataset was constructed up to 2005 to check the post-acquisition performance. Based on the three-year window, the year 2007 was the maximum period for which we could see the post-acquisition performance. To ensure the robustness of the performance, we constructed the time frame based on a five-year window; the maximum period we could measure was 2005.

Although we were able to build data up to 2010, we constructed the dataset based on a five-year horizon to measure M&A performance for three years and post-acquisition performance two years later, so the maximum period we could measure was 2005. Control variables were constructed from the COMPUSTAT database. Additionally, we used SEC filings with U.S. companies and LexisNexis to collect data on acquiring and target firms not included in the COMPUSTAT database. After applying these conditions, 380 acquisitions were included in the analysis [1].

This study was conducted using the Stata program. A negative binomial regression was conducted to test the hypothesis since the dependent variable of this study—innovation performance—is a count variable consisting of positive integers greater than zero.

4.2. Model Specification

We explored the effect of acquisition rate on post-acquisition innovation performance using negative binominal regression tests. We regressed acquisition rate variables on structural integration and several firm-level control variables. We estimated the following negative binominal regression model to examine our hypotheses:

$$\begin{aligned} InvPerf_i = & \beta_0 + \beta_1 AcqRATE_i + \beta_2 StrINT_i \times AcqRATE_i + \beta_3 KnwSIMIL_i + \beta_4 RDInt_i \\ & + \beta_5 AqKnwSTOCK_i + \beta_6 TarTotSale_i + \beta_7 AcqTotSale_i + \beta_8 CEOTO_i + \beta_9 TechRTN_i \\ & + \beta_{10} Industry_i + \beta_{11} Year_i + \varepsilon_i \end{aligned}$$

4.2.1. Independent Variable

Acquisition Rate

The acquisition rate, *AcqRATE*, is the total number of mergers and acquisitions bought by an acquiring firm at a given time [1,5]. Based on the literature [1,32], we measured it as the average number of acquisitions made by the acquiring firm during the five years prior to the acquisition.

4.2.2. Dependent Variable

Post-Acquisition Innovation Performance

Post-acquisition innovation performance, *InvPerf*, was measured by the patents filed by the acquirer after the merger [1,25]. We measured the post-merger innovation performance by identifying patents filed by acquired firms in the five years following the merger [10].

4.2.3. Moderator

Structural Integration

We measured structural integration, *StrINT*, by checking the presence of the acquiring firm's name in patent applications after the acquisition, as well as profit and loss (P&L) accounts in COMPUSTAT [22] and in press releases and articles [49]. If the target firm continued to appear in any way after the acquisition, we coded it as "0" to indicate that no structural integration occurred. Conversely, if the target firm did not appear in these sources, we coded it as "1", reflecting that structural integration occurred.

4.2.4. Control Variables

We used several control variables in this study. First, we controlled for the size of the acquiring and target firms, obtained by taking the logarithm of their pre-merger sales: *TarTotSale*, *AcqTotSale* (available from COMPUSTAT). Second, we controlled for resource heterogeneity, *AqKnwSTOCK*, given that the heterogeneity of the resources of the acquiring and target firms is an important factor to consider in the acquisition process, as it affects how the resources of the merged firm are absorbed and understood [1,10,49]. To control for knowledge similarity, *KnwSIMIL*, we first measured the number of patents cited after the acquisition of the acquiring firm. We removed the repeated patents of the acquiring and acquired firms to create a list of patents filed. These unique patents are representative of each firm's knowledge base. Knowledge similarity is the number of common patents appearing in the acquirer's and target's knowledge base divided by the target's knowledge base [1,10,50]. Fourth, we included the acquiring firm's R&D intensity, *RDInt* (R&D expenditures/sales), to control for the extent to which the firm focused on internal technology development [1,51].

We also included CEO turnover, *CEOTO*, as a control variable because the CEO turnover of target firms may impact a firm's innovation performance after an acquisition. It is also important to consider economic difficulties during the period of an M&A [52,53]. Considering the impact on shareholders after the M&A, we expected CEO turnover to affect firm performance. To measure CEO retention in target firms, we examined all news articles related to the given acquisition deals, the LinkedIn profiles of CEOs, and the Securities

and Exchange Commission’s EDGAR database to identify the turnover events of target firms’ CEOs after acquisitions. Based on the extracted information, we coded 1 if the given target firm’s CEO took charge in a position at the target firm two years after the acquisition; otherwise, we coded 0.

Therefore, we included CEO turnover in our control variables. We also controlled for technology relatedness (*TechRTN*) between acquiring and target firms by comparing similarities in their three-digit technology class codes provided by the SDC Platinum Database.

Finally, we controlled for the fiscal year (*Year*), and the SIC industry (*Industry*) of acquiring firms.

5. Results

5.1. Descriptive Statistics

Table 1 shows the descriptive statistics of all variables used in this study’s statistical analysis and the Pearson’s correlation analysis results are in Appendix A to reveal the relationship between variables. The total number of observed variables is 380. If the correlation coefficient between two variables is between 0.2 and 0.4, the correlation between them is usually low, and if it is above 0.4, the correlation is high. In addition, if the correlation coefficient between independent variables is above 0.8, multicollinearity may exist. As a result of the correlation analysis, all variables in this study showed correlation values below 0.8.

Table 1. Summary statistics.

Constructs	Mean	S.D.	Min	Max
1. Innovation Performance	8.11	27.02	0	284
2. Acquisition Rate	1.52	1.65	0	13
3. Structural Integration	0.48	0.50	0	1
4. Total Sales of Target Firm	1.68	0.79	−1.43	4.14
5. Total Sales of Acquiring Firm	2.86	1.08	−0.44	5.09
6. Acquiring Firm’s Knowledge Stock	12,649.12	33,481.75	0	278,812
7. R&D Intensity (Acquiring Firm)	0.95	7.32	0	97.91
8. Knowledge Similarity	0.14	0.22	0	1
9. CEO Turnover of Target Firm	0.67	0.46	0	1
10. Technology Relatedness	1.49	1.01	0	3
11. Industry Relatedness	2.67	1.38	0	4

5.2. Testing the Hypotheses

We conducted a negative binomial regression analysis to test the effect of the acquisition rate on post-acquisition innovation performance. Regression analysis is not possible when the dependent variable is a count variable and has a large degree of spuriousness. In such cases, the analysis techniques used were Poisson analysis and negative binomial regression. The dependent variable in this study was the countable variable of innovation performance, which had a high degree of skewness. However, Poisson analysis can be used when the variance is equal, while negative binomial regression can be used when the variance is not constant (high variance). In this study, we used negative binomial regression to test our hypotheses.

The analysis was conducted by analyzing the independent variable, the acquisition rate, and the interaction effect of the independent variable with the moderator variable—structural integration. In addition, the sales volume and innovation activities of the acquiring and acquired companies, innovation activities after the acquisition, the similarity of knowledge (knowledge relatedness), R&D intensity, the CEO turnover of target firms, and

the knowledge repository of the acquiring firms were analyzed as control variables. Table 2 shows the results of the analysis.

Table 2. Negative binominal regression results.

Variables	Model 1	Model 2	Model 3
Total Sales of Target Firm	0.6975 ***	0.6871 ***	0.6772 ***
	0.1360	0.1349	0.1355
Total Sales of Acquiring Firm	0.1362	0.2618 *	0.2750 *
	0.1419	0.1529	0.1526
Knowledge Similarity	4.5818 ***	4.6462 ***	4.6710 ***
	0.6135	0.6198	0.6208
R&D Intensity (Acquiring)	0.0161	0.0191	0.0181
	0.0158	0.0159	0.0159
Acquiring Firm’s Knowledge Stock	0.0000 ***	0.0000 ***	0.0000 ***
	5.44×10^{-6}	6.08×10^{-6}	6.17×10^{-6}
Acquisition Rate		−0.1817 **	−0.1420
		0.0800	0.0924
Structural Integration	−0.8086 ***	−0.7812 ***	−0.5873 **
	0.2284	0.2254	0.3005
Acquisition Rate × Structural Integration			−0.1204
			0.1230
CEO Turnover of Target Firms	Yes	Yes	Yes
Technology Relatedness	Yes	Yes	Yes
Year Control	Yes	Yes	Yes
Industry Control	Yes	Yes	Yes
Number of Observations	380	380	380
Loglikelihood	−788.04281	−785.65966	−785.18832
Chi-Square	5503.63	5507.49	5500.56
Pseudo R ²	0.0976	0.1003	0.1009

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

In the negative binomial regressions, the beta coefficient indicates the influence of a unit change in the independent variables on the difference in the log values of the outcome variable [54]. Calculating the exponent of both sides of the negative binominal regression equation results in the incidence rate ratio (IRR), which is the relative difference in the outcome variable for a unit change in the predictor variables.

To confirm Hypothesis 1, that innovation performance decreases with a high acquisition rate, Model 2 in Table 2 shows that innovation performance is significant in the direction of (−) with a high acquisition rate ($\beta = -0.18, p = -0.023, p < 0.05$), as predicted by the hypothesis. A one-standard deviation (S.D. = 1.65) increase in the acquisition rate results in an IRR of $\exp(-0.18 \times 1.65) = 0.74$, a 26 percent decrease in the post-acquisition innovation performance. Therefore, Hypothesis 1, which states that innovation performance will decrease when a company conducts simultaneous M&As within a short period, is supported.

Model 3 in Table 2 shows the moderating effect. In this regard, a non-significant outcome ($\beta = -0.142, p = 0.124$) demonstrates that when an acquiring firm does conduct structural integration, there exists a negative relationship between a high acquisition rate

and post-acquisition innovation performance. Structural integration negatively moderates the negative relationship between the high acquisition rate and the post-merger innovation performance. Therefore, Hypothesis 2 is not supported. When firms make acquisitions, they can learn from previous experiences. However, the longer the gap between acquisition events, the less effective the learning from previous acquisitions is. Decision-makers can focus on routinized or well-learned activities, but when they need to make their own decisions, their attention is distracted, and their focus becomes selective. In addition, the longer the gap between arguments, the more the decision-maker's attention is affected by the context in which they are leading the argument.

Therefore, the focus of an individual's attention and behavior becomes contextualized, affecting acquisition performance. Since there are both learning-influenced acquisition performances and decision-maker attention-based acquisition performances, the structural integration effect could be weakened.

5.3. Robustness Check

We explored an alternative moderating variable that might influence the dependent and independent variables. We used knowledge similarity, although there was no hypothesis related to knowledge similarity. We performed a robustness check analysis using knowledge similarity. Knowledge similarity seems to negatively moderate the negative relationship between the acquisition rate and the post-acquisition performance, as knowledge similarity leads to better absorption of the target firm's knowledge.

Although the moderating effect of knowledge similarity may be positive due to the absorptive capacity of the target firm, meaning it absorbs knowledge better, robustness checks show that it makes the negative relationship between the acquisition rate and innovation performance weaker. This is because the overlap between the target firm's knowledge and the acquiring firm's knowledge seems to increase the redundancy of knowledge, which may reduce the effectiveness of learning. Knowledge overlap can make it difficult to recombine innovations, which can hurt the creation of innovations. Overlapping knowledge with the target firm can lead to positive firm performance by focusing more on exploitation, but on the other hand, more overlapping knowledge can lead to difficulties in innovation performance by focusing only on exploitation.

6. Discussion

In the ICT (Information and Communication Technology) sector, new firms emerge and disappear as quickly as they arise, largely due to the relatively low initial investment in fixed assets compared to other industries. Over the past few decades, a handful of ICT-based companies, such as Apple, Alphabet, and Microsoft, armed with new technologies and ideas, have expanded their businesses with artificial intelligence, maintaining rapid growth and solidifying their current dominant positions in their industries. The highly competitive and winner-takes-all nature of ICT-based industries makes it difficult for startups to disrupt the market and gain a competitive advantage based on new technologies alone. This is due to the many mergers and acquisitions of some dominant companies, which makes it difficult for startups to become independent companies.

In the case of the leading ICT-based firms, many of which have made many M&A deals in recent years and are investing in A.I. (artificial intelligence) to improve their performance, it is important for leading firms that have already established a dominant position to maintain their competitive advantage through continuous R&D and market research. However, since it is not practical to master and cultivate every skill, incumbent firms are actively seeking to acquire the technology of startups. In fact, firms in leading positions such as Alphabet, Apple, and Facebook are actively acquiring startups that are equipped with artificial intelligent-related technologies that are driving the fourth industrial revolution, such as artificial intelligence and voice recognition [55]. In other words, for firms that have already entered the market based on ICT-related technologies,

it is important to continuously acquire new technologies and ideas through mergers and acquisitions as well as by strengthening their internal capabilities [56].

When acquiring other firms' technology, considering the post-acquisition process is inevitable. During that process, it is important to contemplate what is needed when pursuing an acquisition. This study empirically analyzed 380 cases of technology mergers and acquisitions of U.S. publicly traded firms from 1990 to 2005. We examined the relationship between the acquisition rate and innovation performance and the moderating effect of structural integration.

The results show that a high acquisition rate leads to a decrease in innovation performance, and although the relationship between M&A experience and innovation performance has been studied from the perspective of M&A experience, this study examined the relationship from an attention-based view. We used the concept of the acquisition rate rather than the acquisition experience, and our results show that a high acquisition rate reduces innovation performance. The moderating effect of structural integration was not significant. This study confirmed that the absence of post-merger structural integration does not mitigate the negative impact of the acquisition rate.

Moreover, this study shed new light on the importance of viewing M&As as a process for firms engaged in multiple and simultaneous acquisitions. While prior research on M&As has focused primarily on individual acquisitions, our findings suggest that the acquisition rate is an important factor affecting firm performance for firms with a high frequency of acquisitions.

By applying an attention-based view of past M&A experience as a learning perspective, rather than as an accumulation of knowledge, we reveal a new area of research that mitigates the negative relationship of frequent M&As.

Exploring the impact of the acquisition rate on firm performance has several practical implications. First, it helps decision-makers regard past experiences as an important factor when making acquisition decisions. This could lead to better negotiation of deals, as accumulated experience could help devise an acquisition strategy. Second, when making acquisition decisions, firms could notice the importance of structural integration. Although this study did not support the moderating role of structural integration, it is still mandatory when pursuing M&As. Finally, with the cumulative knowledge gained from previous acquisition experience, companies will be able to act more cautiously when conducting structural integration to minimize negative outcomes.

In addition, the finding that a high acquisition rate negatively affects firm performance suggests the need for research on how to properly allocate limited attention to organizational activities that affect the quality of future decisions. Although we were unable to confirm that structural integration reduces the negative impact of a high acquisition rate, we consider it worthwhile to try identifying other moderating variables at the firm level.

One of the limitations is related to the time frame of the acquisition rate. Although the available maximum year was until 2010, to check the robustness, this study was conducted for a short period and was unable to consider economic trends. Further studies could extend the time frame and examine the demographic variables that could affect the post-acquisition performance.

Our study's focus on firms that were actively merging and acquiring limits the generalizability of the results. However, it was necessary to focus on variables that only play a role when a firm is merging or acquiring another firm. Furthermore, although this study focused on technology acquisitions, it could be extended to other forms of M&A activities. This study provides an interesting research direction to revisit the literature on M&A experiences from a learning perspective. Future research should focus on how to construct and modify the variables necessary to mitigate the negative effects of acquisition rates. Despite these limitations, this study adds to the literature on M&A characteristics in shaping the impact of the acquisition rate and managerial capabilities to deal with it effectively.

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Appendix A

Table A1. Correlation table.

Constructs	1	2	3	4	5	6	7	8	9	10	11
1. Innovation Performance	1										
2. Acquisition Rate	0.04	1									
3. Structural Integration	−0.14 ***	−0.00	1								
4. Total Sales of Target Firm	0.14 ***	0.24 ***	−0.18 ***	1							
5. Total Sales of Acquiring Firm	0.13 ***	0.53 ***	−0.20 ***	0.44 ***	1						
6. Acquiring Firm's Knowledge Stock	0.34 ***	0.43 ***	−0.06	0.13 ***	0.41 ***	1					
7. R&D Intensity (Acquiring Firm)	−0.02	−0.08 *	0.01	−0.17 ***	−0.29 ***	−0.04	1				
8. Knowledge Similarity	0.26 ***	0.27 ***	0.12 **	0.03	0.22 ***	0.39 ***	−0.05	1			
9. CEO Turnover of Target Firm	−0.01	0.12 **	0.07	0.00	0.06	0.06	0.05	0.08	1		
10. Technology Relatedness	0.08	−0.13 **	0.04	−0.01	−0.13 ***	0.02	−0.01	0.09 *	0.07	1	
11. Industry Relatedness	0.04	−0.30 ***	0.08 **	−0.00	−0.26 ***	−0.18 ***	0.04	−0.02	−0.01	0.37 ***	1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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