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The Dark Side of Inventor Retention

: How Too Much Retention Deters Knowledge Integration after M&A

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ABSTRACT

Does more post-M&A inventor retention *always* lead to more M&A knowledge integration and synergies? Extant emphasis on the acquired firm' s role as a knowledge provider in an M&A has thus far validated positive aspects of acquired firm inventor retention. Our research sheds light on a complementary yet overlooked perspective of acquired firms as knowledge recipients, and examines how the comprehensive analysis of the knowledge flow mechanism of an M&A may challenge the long-held belief on the benefits of acquired firm inventor retention and reveal its potential dark side. To investigate the negative impact of too much retention in knowledge-intensive M&As, we study the impact of inventor retention on post-M&A knowledge integration between the acquiring and acquired firm. We predict that the retention of inventors from the acquired firm will have a positive effect on knowledge integration only up to a point, beyond which increased retention will trigger organizational inertia of the acquired firm that negatively affects the integration of knowledge. We further delve into how this inverted U-shaped relationship is moderated by two relative knowledge aspects of the acquired firm – relative size of the acquired knowledge base and relative relatedness of the acquired knowledge base. By examining mergers and acquisitions within the pharmaceutical and semiconductor industry, we obtain empirical findings that significantly support our hypotheses. This research offers both theoretical and managerial implications by introducing a complementary perspective on the knowledge flows of M&As, and thus broadens our understanding of inventor retention.

Keywords: Knowledge Integration, Inventor Retention, M&A
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TABLE OF CONTENTS

1. **INTRODUCTION**

The surge in knowledge-intensive mergers and acquisitions, where acquiring companies seek gaining access to new specialized knowledge and exploiting knowledge synergies from the acquired firm, has increased the importance of retaining acquired firm's employees as crucial knowledge resources (Gold, 1987; Miller, 1990; Gerpott, 1995; Ernst & Vitt, 2000). The view of regarding acquired firms as *knowledge providers* and acquired employees as knowledge resources has triggered the development of a great body of research on the solid belief of the ***positive*** aspects of employee retention. Strategic management scholars have conducted extensive research on the benefits of retaining acquired firm's employees, ranging from top-managers to technological engineers, in achieving substantial post-M&A knowledge performance (Castanias & Helfat, 1991; Cannella & Hambrick, 1993; Ranft & Lord, 2002; Ranft, 2006).

Our research has come to pose a question to this ongoing stream of literature: will an M&A successfully retaining ***all*** employees of the acquired firm achieve the most knowledge integration and synergies? That is, will post-M&A knowledge integration between the merged firms linearly increase with the degree of employee retention? Real-world cases such as the merger between Takeda Pharmaceuticals Company and Millennium Pharmaceuticals Inc. seem to suggest that our question signals to a valid argument against the long-standing belief on the merits of more employee retention (O'Reilly, Itoh, Kimura, Beaumont, & Kneller, 2012). Takeda

Pharmaceuticals acquired Millennium Pharmaceuticals in 2008 with hopes of achieving knowledge synergies through the world-class inventors of Millennium, and thus strived to retain large numbers of Millennium inventors. High retention rates, however, brought more harm than good. Excessive retention increased the organizational inertia of Millennium Pharmaceuticals, making it more determined to operate as an independent unit and resistant to receiving new knowledge flow or practices brought by Takeda. This deterred the integration of Millennium Pharmaceuticals to Takeda Pharmaceuticals, subsequently resulting in the lack of knowledge integration between the two firms – one of the primary motivations of the acquisition. As such, real-life examples illustrate that positive effects of employee retention do not persist with the increase of retention as to make "the more the better" applicable to post-M&A retention. The hindrance that excessive employee retention casts on the knowledge receiving mechanism of acquired firms seems to allude to the existence of an unprecedented ***dark side of retention***, which unlocks itself in the face of too much retention.

Our study strives to take a step closer to reality by illuminating the negative side of employee retention through incorporating the complementary, yet overlooked, view of recognizing the acquired firm's important role as a *knowledge recipient*, as well as a *knowledge provider*, in attaining knowledge integration. Specifically, we argue that the benefits of retaining acquired firm's inventors, or key employees in the context of knowledge-intensive M&As (Ernst & Vitt, 2000),

that derive from the knowledge providing mechanism of acquired firms will only persist to a certain point. Beyond such point retaining additional inventors is predicted to cast negative impact on post-M&A knowledge integration through the knowledge receiving mechanism of acquired firms. We suggest an inverted-U shaped relationship will form between the extent of acquired firm inventor retention and the degree of subsequent knowledge integration between the acquiring and acquired firms. We attribute such overriding negative impact of inventor retention, conspicuous beyond an excessive level of retention, to the strengthened organizational inertia of the acquired firm as knowledge recipients. Organizational inertia is defined as limitations on the ability and motivation of organizations to adapt to external changes and opportunities (Hannan & Freeman, 1977, 1984; Morison 1966), and is slackened by the restructuring of the original organization formation (Barkema & Schijven, 2008) or negative feedback on existent routines (Huff, Huff, & Thomas, 1992; Lant, Milliken, & Batra, 1992). High levels of retention of the acquired firm implies a lack of disruption or discontinuity within the acquired firm to break the grips of its organizational inertia (Virany, Tushman, & Romanelli, 1992), and conveys a positive feedback to the acquired firm on its existing strategies and practices (Pfeffer, 1981). We argue that, through these routes, excessive retention amplifies the organizational inertia of the acquired firm, making the acquired firm more resistant as a knowledge recipient to assimilate the influx of new knowledge of the acquiring firm, conclusively

hindering post-M&A knowledge integration.

We further delve into how the inverted U-shaped relationship is moderated by the quantitative and qualitative relative knowledge aspects of the acquired firm – relative size of acquired knowledge base and relative relatedness of acquired knowledge base. We claim that the curvilinear relationship is strengthened by greater relative size of the acquired knowledge base, while weakened by greater relative relatedness of the acquired knowledge base. We predict that greater relative size of the acquired knowledge base increases positive marginal impact of retention through enhanced quantity and quality of knowledge embedded in retained inventors (Ahuja & Katila, 2001), while intensifying the negative marginal effect of organizational inertia triggered by excessive retention due to higher reliance on existent superior knowledge sourcing and creating patterns (Ranft & Lord, 2002; Song, Almeida, & Wu, 2003). We further expect greater relatedness of knowledge bases to decrease the positive marginal benefit of inventor retention due to diminished availability of non-repetitive knowledge to integrate (Ahuja & Katila, 2001), while simultaneously decreasing the negative marginal effect of organizational inertia triggered by excessive retention, since the receipt of relatively related knowledge sources and practices offset less organizational inertia due to less unfamiliarity and uncertainty (Song, Almeida, & Wu, 2003).

To empirically test the hypothesized effects, we conduct regression analysis on the data of mergers and acquisitions in the pharmaceutical and semiconductor

industries, from years 1986 to 2008. SDC Platinum is used to identify mergers and acquisitions implemented within each industry, and USPTO patent data is utilized to trace inventor retention and patent citations, and to track measures of post-M&A knowledge integration, relative size of knowledge bases, and relative knowledge relatedness. We generate variables that help eliminate potential biases through the extensive use of COMPUSTAT data. The results of the negative binominal regression model show considerable support for our hypotheses.

The results of this study theoretically contribute to extant literature on the knowledge flow of M&As and subsequent retention of employees by offering a more comprehensive analysis. Our study sheds light on the acquired firm's role as knowledge recipients, which has so far been excluded from scholarly spotlight in the stream of management literature. Through this incorporation we substantiate that employee retention in the face of a merger or acquisition is not always for the better, and empirically verify the existence of a darker side of retention. We believe these complementary propositions open doors to further studies that apply and combine the well-established prior research of mergers and acquisitions to the new finding of the knowledge receiving mechanism of acquired firms and the consequent demerits of retention. On top of broadening the horizons of research and understanding, our study offers implications to managers by conveying a counter-intuitive message on the issue of post-M&A retention.

2. THEORY AND HYPOTHESES

2.1. Mergers & Acquisitions, Knowledge Integration, and Inventor Retention

Firms rely on mergers or acquisitions to obtain valuable resources that are difficult to acquire through market mechanisms (Capron, Dussage, & Mitchell, 1998). Organizational knowledge and technological expertise that are developed internally through on-going R&D experiences are notable examples of such resources (Zander & Kogut, 1992; Song, Almedia, & Wu, 2003), and an increasing number of firms are conducting mergers and acquisitions in order to procure these resources without having to confront the burden of time-consuming, path-dependent, and uncertain processes of internally accumulating technological knowledge (Gerpott, 1995; Dierickx & Cool, 1989; Leonard-Barton, 1995; Puranam & Srikanth, 2007). A significant component of such knowledge and technological capabilities that firms aspire to acquire is tacit and embedded in individual employees, and consequently difficult to transfer and preserve without the movement of the employees themselves (Nonaka, 1991; Argote & Ingram, 2000). In this vein, the turnover of acquired firm's employees, as emphasized by Ranft and Lord (2002), becomes comparable to knowledge "walking out the door". The failure to retain employees of the acquired firm in the context of a merger or acquisition thus implies the failure to acquire and transfer the technological

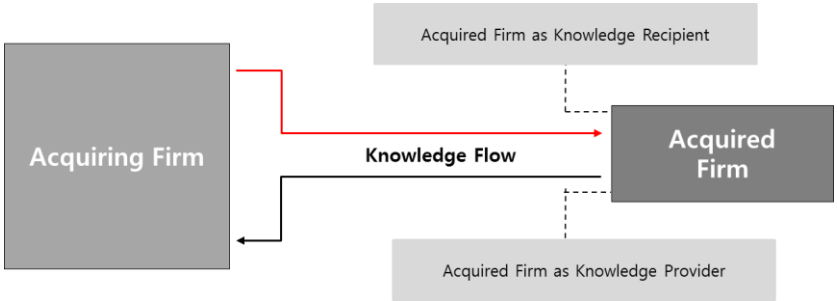
expertise and knowledge of the acquired firm.

Considering these reasonable grounds of looking onto acquired firms as knowledge providers and acquired employees as crucial knowledge resources in the context of mergers and acquisitions, it seems natural that M&A research has made much progress in uncovering the ***positive*** aspects of employee retention of the acquired firm. Strategic management scholars have examined how the retention of employees – ranging from top managers to technological engineers – of the acquired firm enhances post-M&A performance. Researchers validated that the turnover of top management team of acquired firms is harmful to post-acquisition performance (Castanias & Helfat, 1991; Cannella & Hambrick, 1993). As knowledge and skills of particular value in a knowledge-intensive merger reside not only in executives but more so in technical personnel or inventors (Kozin & Young, 1994; Badaracco, 1991; Nelson & Winter, 1982; Nonaka, 1994), studies were recently extended to examine how the retention of R&D personnel and engineers, facilitate the preservation and transfer of tacit knowledge. (Ranft & Lord, 2002; Ranft, 2006). Thus, prior literature has consistently posed that with the loss of acquired firm's key employees, whether it be top managers or technological knowledge holding inventors, acquirers may find themselves stripped of the skills and capabilities that largely motivated the acquisition in the first place.

This body of research addressing the positive side of post-M&A employee retention has emphasized the knowledge flow from acquired firms to acquiring

firms, and has focused on the role acquired firms take as ***knowledge providers*** in an M&A. However, mergers and acquisitions are increasingly conducted not only to acquire and preserve acquired firm's knowledge, but also to create value through further streams of innovation and synergies by integrating the knowledge bases of the acquired and acquiring firms (Huber, 1991; Puranam, 2001; Larsson & Finkelstein, 1999). In order for mergers and acquisitions to achieve such intentions, both the acquiring and acquired firms must strive to actively assimilate and integrate the two knowledge bases. In this vein, our research emphasizes the importance of complementing the extant analysis on the one-way knowledge flow from the acquired firm to the acquiring firm with the knowledge flow from the acquiring firm to the acquired firm. Thus we suggest the acquired firm's role of receiving and assimilating knowledge from the acquiring firm becomes equally important as providing knowledge *to* the acquiring firm, in order to achieve the ultimate purpose of creating value through knowledge integration (as shown in [Figure 1] below). We propose that in the event of a merger or acquisition the acquired firm not only functions as a knowledge provider, as emphasized in previous studies, but also plays an important role as a ***knowledge recipient*** of the knowledge flow from the acquiring firm, which has yet to receive theoretical attention.

[Figure 1 Knowledge Flow Model between Acquiring and Acquired Firms]



On broadening the lens focused on acquired firm's role as a knowledge provider to include the essential, yet overlooked, role of an acquired firm as a knowledge recipient, we direct our interest to the impact that retention of acquired firm's employees has on these two roles, and subsequently on knowledge integration. Retention of acquired firm's employees has been validated by prior research to exert positive effects on the knowledge providing mechanism of acquired firms, through the increase of knowledge resource preservation. In our research, we examine how the increase of acquired firm's retention may differentially impact the receiving mechanism of knowledge flow from the acquiring firm and subsequent knowledge integration through increased organizational inertia, shedding light on an unprecedented dark side of retention that hinders knowledge integration.

With our emphasis on the knowledge flow between the merged firms and consequent knowledge integration, we particularly focus on the retention of key knowledge holding employees, or inventors, of the acquired firm. Management

scholars have accentuated that employees crucial in a firm's R&D process influence the extent to which technological knowledge is diffused and generated (Nerkar & Paruchuri, 2005). Particularly in knowledge intensive mergers, the experience and skills of research and development personnel or inventors are known to be some of the most critical assets (Kozin & Young, 1994; Ranft & Lord, 2002). Recent M&A retention studies have adhered to such literature and limited their focus on R&D employees or inventors (e.g. Ernst & Vitt, 2000; Ranft & Lord, 2002; Ranft, 2006). Following this stream of literature, we focus our analysis on the retention of inventors of the acquired firm.

2.2. The Dark Side of Inventor Retention and Organizational Inertia

Knowledge integration after mergers or acquisitions is defined as the creation of new knowledge by recombining knowledge from both the acquiring and acquired firms. We predict that through the influential forces exerted by the differing roles of acquired firms as knowledge providers and knowledge recipients, retention of inventors of the acquired firm is likely to have a non-monotonic impact on subsequent knowledge integration. Knowledge integration will increase with rising inventor retention of the acquired firm due to the benefits of the knowledge providing mechanism, but beyond some optimum point of retention, excessive retention will trigger the negative impact of the knowledge receiving mechanism, causing knowledge integration to decrease with additional retention.

The *knowledge providing mechanism of acquired firms* in a merger or acquisition illustrates the positive effect inventor retention of acquired firms has on knowledge integration. The knowledge-based view and prior studies on post-M&A retention suggest that increased retention of acquired firm's employees, especially those holding related knowledge and technical expertise, signals higher levels of knowledge acquisition and preservation (Ranft & Lord, 2000; Ranft, 2006). Our study persists with this view, and further proposes that the increased preservation of knowledge through inventor retention enhances future streams of integrative and combinatory innovations, in reason to increased knowledge bases to extract and combine from. As Ahuja and Katila (2001) mention in their seminal research, the number of potential combinations and integrations that a merged firm can generate from its knowledge elements increases with the extent of knowledge acquired and preserved.

Nonetheless, such positive impact that inventor retention of the acquired firm holds on knowledge integration is predicted to have diminishing rates of return. While the retention of more inventors of the acquired firm continue to augment the level of knowledge resource acquisition, the actual acquisition of new and non-repetitive knowledge contributing to knowledge integration will increase in diminishing rates and, subsequently, plateau. To speak plainly, in instances where the inventor retention ratio is already high, an additional retained inventor is more likely to bring similar and repetitive knowledge, contributing only a negligible

amount of new knowledge to the merged firm. The decreasing increments to new knowledge induces diminishing returns to subsequent combination and integration from building on the same knowledge (Ahuja & Katila, 2001). To sum, we suggest inventor retention of the acquired firm exerts positive, yet gradually diminishing, effects on subsequent knowledge integration when focusing on acquired firms' role as knowledge providers.

We argue that, at the same time, the complementary *knowledge receiving mechanism* of the acquired firm establishes a darker side of inventor retention due to the offset of acquired firm's organizational inertia. According to prior studies, organizational inertia is defined as the force that sets limitations on the ability and motivation of organizations to adapt in the face of significant external change (Hannan & Freeman, 1977, 1984; Morison, 1966; Miller & Friesen, 1980). We suggest that while knowledge-intensive M&As induce acquired firms to face turbulent external changes by introducing new knowledge creating processes and knowledge sources of the acquiring firm (Ahuja & Katila, 2001), excessive retention will trigger organizational inertia as to obstruct the ability and motivation of acquired firms to receive and assimilate new knowledge and adapt to new knowledge creating routines of the acquiring firm. In other words, organizational inertia of the acquired firm set forth by too much retention would amplify the acquired firm's propensity to "stick to their knitting" and resist the influx of knowledge resources and knowledge processes. We claim that excessive retention

strengthens such organizational inertia of the acquired firm through two channels: the lack of disruption or discontinuity in the organizational formation of the acquired firm and positive feedback that high retention ratio signals to the acquired firm.

Primarily, we predict high levels of inventor retention of the acquired firm to uphold the acquired firm's organizational inertia by exerting little disruption and discontinuity to the composition of organization actors and thus the original organizational formation of the acquired firm. Organizational inertia is known to be slackened by forces that break the cohesiveness of organizations, such as the restructuring of the original organization formation (Barkema & Schijven, 2008), while strengthened by the increased stability of organizational membership (Katz & Allen, 1982). March (1991) affirms this in his seminal study that "introducing personnel turnover in an organization produces variability to the organization", without which rapid socialization into existent routines of an organization tends to reduce exploration to new knowledge or sourcing patterns. Virany, Tushman, and Romanelli (1992) empirically validate this, examining how changes in executives or employees may be used to generate disruption and break the grips of organizational inertia, initiating discontinuous changes in strategy. In such vein, the lack of changes in the organizational formation and membership of the acquired firm through the excessive retention of acquired firm's inventors implies the deficiency of forces to unchain the fetters of organizational inertia.

Additionally, excessive inventor retention reinforces organizational inertia by conveying a positive feedback to the acquired firm, strengthening the confidence and reliance acquired firms hold on existent patterns and practices. Post-M&A employee turnover sends a negative symbolic message to the acquired firm (Pfeffer, 1981), ensuing threats to existent routines and practices and palpating changes to the acquired firm's ongoing strategy (Canella & Hambrick, 1993). Such negative feedback on current routines have been confirmed to break the grips of organizational inertia (Huff, Huff, & Thomas, 1992; Lant, Milliken, & Batra, 1992). Employment continuity of the acquired firm after an M&A, on the other hand, tends to preserve strategic continuity of the acquired firm because it assures organization members that the acquiring firm supports the acquired firm's strategies and practices (Canella & Hambrick, 1993). Thus, positive feedback signaled by the high retention ratio of an acquired firm incurs the continuance of existent knowledge creating and sourcing patterns and processes, reinforcing rather than breaking the organizational inertia. The two channels of influence exerted by excessive retention combine to make the increased retention of inventors conserve and strengthen the force of organizational inertia in the acquired firm.

We assert that the reinforcement of organizational inertia of the acquired firm will limit the acquired firm's ability and motivation as a knowledge recipient, thus hindering knowledge integration. Acquired firms are offered new opportunities and changes through the availability of novel knowledge sourcing and creating

processes from the acquiring firm, in a knowledge-intensive M&A. Organizational inertia, which make firms resistant to new adaptations and more reliant on existent practices (Nelson & Winter, 1982; Hannan & Freeman, 1984), will drive inventors of the organization to persist existent knowledge search and sourcing patterns, and to separate themselves from external sources of knowledge and technical information (Katz & Allen, 1982). As the receipt and assimilation of acquiring firm's knowledge by the acquired firm is an essential part for the realization of knowledge integration, the retention of too much inventor retention that triggers the organizational inertia of the acquired firm casts negative impact on post-M&A integration of knowledge in the face of receiving knowledge.

By combining the influence inventor retention exerts on both the knowledge providing and knowledge receiving mechanism of the acquired firm, we suggest that the positive impact retention has on the knowledge providing mechanism increases the integration of knowledge up to a point, beyond which the negative impact of retention brought by the knowledge receiving mechanism outweighs the benefits, to decrease the knowledge integration of the merged firms. Thus, *moderate* degrees of inventor retention after an M&A provide both the benefits of enhancing the supply of knowledge resources for possible combinations, while conveying sufficient discontinuity and negative feedback to undermine the organizational inertia of the acquired firm. Based on the above arguments, M&A deals characterized by a moderate level of inventor retention of the acquired firm

are likely to provide the most significant positive impact on the merged firm's subsequent knowledge integration. Accordingly, we predict:

Hypothesis 1: The proportion of retained inventors of the acquired firm has an inverted-U shaped relationship with post-M&A knowledge integration.

2.3. The Moderating Effects of Relative Knowledge Aspects of the Acquired Firm

We extend the hypothesis presented above by examining moderating effects to the relationship between inventor retention and knowledge integration. Specifically, two moderating factors are investigated: 1) relative size of acquired knowledge base and 2) relative relatedness of acquired knowledge base. These two attributes embody the two dimensions of relative difference in knowledge bases, as the relative size of acquired knowledge base signifies the quantitative relative aspect, while the relative relatedness of the acquired firm knowledge base concerns the qualitative relative aspect. Prior M&A research has stressed and examined these relative characteristics of the knowledge base of the acquired firm as central factors that affect knowledge flows between merged firms (e.g. Ahuja & Katila, 2001). Following this line of thought, we examine how the two relative knowledge properties influence the knowledge providing and receiving mechanisms of the acquired firm, and thus moderate the association between inventor retention of the acquired firm and knowledge integration.

2.3.1. Relative Size of Acquired Knowledge Base

The relative size of acquired knowledge base indicates the level of knowledge and technology held by the acquired firm in comparison to the acquiring firm (Lubatkin, 1983). We propose that this characteristic influences how the retention of inventors affects the knowledge providing and knowledge receiving mechanisms of the acquired firm and subsequent knowledge integration. Specifically, we predict that greater relative size of the acquired knowledge base intensifies both the positive and negative marginal effects that retention exerts on knowledge integration, thus strengthening the curvilinear relationship.

On focusing on acquired firms' role as knowledge providers, greater relative size of the acquired knowledge base implies the increase of the quantity and quality of knowledge preserved and provided through the retention of inventors (Ahuja & Katila, 2001). Therefore, the retention of more acquired firm inventors will increase the potential knowledge recombination and integration in greater increments when an acquired firm with greater relative size of knowledge base is acquired, as compared to the case of acquiring a firm with smaller relative knowledge base. In other words, relative size of the acquired knowledge base amplifies the positive marginal effect of inventor retention through the knowledge providing mechanism of the acquired firm.

Regarding the knowledge receiving mechanism of the acquired firm, the relative size of acquired knowledge base intensifies the organizational inertia of the

acquired firm triggered by too much inventor retention. We argue that greater relative size of acquired firm knowledge base bolsters organizational inertia of the acquired firm by boosting both the acquired firm's reliance on existing knowledge sourcing and creating patterns and resistance to utilize and assimilate new resources received from an acquiring firm of inferior knowledge base. Greater relative size of acquired knowledge base implies that the acquired firm has experienced acceptable performance from existent routines of knowledge sourcing and creation, leaving the acquired firm with more reason to persist existing practices and little incentive to adapt to new changes (Nelson & Winter, 1982). Further, greater relative size of acquired firm knowledge base increases the acquired firm's resistance to receiving and integrating with new resources from firms, especially those that are inferior to its own. It has been validated that acquired firms with greater knowledge performance engendered hindrances to effective knowledge and technologies transfers between the acquiring and acquired organizations, due to impaired communication (Ranft & Lord, 2002). Wastyn and Hussinger (2011) also illustrate that the overemphasis of internal knowledge and the resistance to assimilate external knowledge is dominant in organizations of relatively higher levels of knowledge performance and resources. Therefore, when acquiring a firm possessing greater relative size of knowledge base, the organizational inertia from retaining excessive inventors of the acquired firm becomes stronger, thus intensifying the negative marginal effects derived from increasing inventor

retention through the knowledge receiving mechanism of the acquired firm.

In combination, as the relative size of acquired firm's knowledge base increases, the inverted-U curve between the retention and the knowledge integration becomes steeper such that achieving the moderate level of inventor retention of the acquired firm is more preferable and important for post-M&A knowledge integration. Therefore we hypothesize that:

Hypothesis 2: The inverted U-shaped relationship between the proportion of retained inventors of the acquired firm and post-M&A knowledge integration is stronger in M&A deals with greater relative size of acquired knowledge base.

2.3.2. Relative Relatedness of Acquired Knowledge Base

The relative relatedness of acquired knowledge base concerns the extent of similarity of the acquired and acquiring knowledge bases (Lane & Lubatkin, 1998). We predict that the relative relatedness of acquired knowledge base will influence the effect inventor retention has on the knowledge providing and receiving mechanisms – both by weakening the impact retention has on subsequent knowledge integration. Increased relative relatedness of the knowledge bases will diminish the value of the knowledge provided through the retention of inventors, while reducing organizational inertia triggered by retention as well.

Greater relative relatedness of acquired knowledge base decreases the novelty and non-repetitiveness of preserved knowledge through retention, while retention

from acquired firms that hold small knowledge overlaps offer more complementary and novel knowledge (Ahuja & Katila, 2001). This implies that the retention of more inventors from an acquired firm with greater relative relatedness of knowledge indicates a slighter increase in the realization of knowledge integration and combination. Thus, greater relative relatedness of the acquired knowledge base weakens the marginal positive effect that inventor retention has on post-M&A knowledge integration through the knowledge providing mechanism.

Meanwhile, relative relatedness of acquired knowledge base engenders influence on the knowledge receiving mechanism of the acquired firm, by decreasing organizational inertia. Organizational inertia is known to be strengthened in the face of new changes that appear to be more unfamiliar and distant from current practices or knowledge (Dutton & Jackson, 1987; Staw, Sandelands, & Dutton, 1981). Smaller relative relatedness of acquired knowledge base indicates that the knowledge resources and patterns of knowledge creation of the acquiring firm are of dissimilar characteristics unknown to the acquired firm. Thus, in order to assimilate and adapt to new changes brought by the acquiring firm, acquired firms must venture out to uncertain fields distant from existent knowledge resources and practices. In such circumstances, the lack of relative relatedness of acquired knowledge base induce more burden and unfamiliarity to the knowledge receiving mechanism of the acquired firm, strengthening the organizational inertia of the acquired firm to persist its existent practices. In support, Song, Almedia, and

Wu (2003) asserted in their seminal paper that firms will value knowledge close to existing technological conditions very highly, while myopically devaluing and resisting more distant knowledge. When acquiring a firm possessing *greater* relative relatedness of knowledge base, such uncertainty and resistance to utilizing and assimilating distant knowledge, and subsequent organizational inertia of the acquired firm is decreased. Therefore with greater relative relatedness of knowledge base, the organizational inertia of the acquired firm from retaining excessive inventors becomes weaker, thus weakening the negative marginal effects derived from increasing inventor retention through the knowledge receiving mechanism.

In summation, as the relative relatedness of acquired firm's knowledge base increases, the inverted-U curve between the retention and the knowledge integration becomes weaker, such that achieving the moderate level of inventor retention of the acquired firm is of less significance for post-M&A knowledge integration. Therefore we hypothesize that:

Hypothesis 3: The inverted U-shaped relationship between the proportion of retained inventors of the acquired firm and post-M&A knowledge integration is weaker in M&A deals with greater relative relatedness of acquired knowledge base.

3. DATA AND METHODS

3.1. Data

Our research analyzes mergers and acquisitions in the pharmaceutical and semiconductor industries, for they provide an ideal setting to test out hypotheses for three reasons. Primarily, the pharmaceutical and semiconductor industries have extensive merger and acquisition history, providing sufficient sample of M&As to conduct empirical tests. Second, these knowledge-intensive industries are well-known to be active in mergers and acquisitions driven largely by motivations of accessing new technology expertise and integrating knowledge bases of the merged firms (Reinhardt, 1999; Sikora, 2000). Lastly, both industries are characterized by appropriability regimes in which patents are key in protecting newly developed technologies, leading to high and significant patenting activity (Cohen, Nelson, & Walsh, 1999; Puranam & Srikanth, 2007).

For the empirical analysis, we identified mergers and acquisitions within the pharmaceutical or semiconductor industries from the SDC Platinum Database (SIC codes 2834 and 3674, respectively). 6283 cases of mergers and acquisitions were initially extracted from the sample period of 1981 to 2008. Among these merger and acquisition cases, the following criteria was utilized to obtain samples that would yield unbiased results. First, we included mergers and acquisitions only if the acquiring firm possessed more than 50% of the acquired firm's share after the M&A transaction. Cases in which the acquirer previously owned more than 50%

of shares before the M&A deal were excluded, to eliminate the possibilities of prior acquisitions and knowledge integration between the firms. Additionally, cases in which the acquiring firm held less than 50% of shares after the M&A deal were further ruled out, to exclude deals motivated as equity investments. Second, we focused on M&A deals that were greater than $10 million and smaller than $500 million. The lower bound of $10 million was set largely due to the fact that firms tend to use a hands-off approach for small acquisitions as their effects are likely to be negligible (Finkelstein & Haleblian, 2002). The upper bound of transaction value was set in reason to M&A literature, which suggests that even in knowledge-intensive industries, large-scale mergers and acquisitions are driven by various motivations other than knowledge integration: for instance, market power and cost reduction through economies of scale (Makri, Hitt, & Lane, 2010). Therefore, by limiting our sample to the middle-value deals, we can minimize potential bias from diverse motivations of a merger and acquisition. Third, M&A deals involving a subsidiary or subunit as either an acquirer or acquiring firm were excluded from the sample, leaving deals made between independent firms (as opposed to divestments). Fourth, to select M&A deals made by established acquirers, the acquiring firm was required to have been continuously listed in COMPUSTAT during the sample period (Puranam & Srikanth, 2007). Lastly, to analyze the relationship between inventor retention and knowledge integration through patent data, the sample was reduced to cases where both the acquiring and the acquired

firm filed at least one patent in the United States Patent and Trademark Office (USPTO) before the acquisition, and the merged firm generated more than one patent within 7 years after the acquisition. These screening criteria resulted in 274 M&A deals, in the reduced sample period of years 1986 through 2008.

3.2. Measures

3.2.1. Dependent Variable

Knowledge Integration. Post-M&A knowledge integration is defined as the creation of new knowledge by combining existing knowledge from both the acquiring and acquired firms. Patent portfolios of the acquiring and acquired firms were used extensively to measure knowledge integration. A patent signifies a unique and novel element of knowledge creation, built from prior patents created earlier on by the same firm or by other firms or institutions (Ahuja & Katila, 2001). All and any of these prior patents referenced by the newly developed knowledge are, as US law obliges patent applicants, specified as citations in the patent document to recognize their contribution to the knowledge embodied in the patent. Thereby, the citations of prior patents of the focal patent effectively represent the flow of knowledge involved in the development of the new knowledge (Song, Almeida, & Wu, 2003). Based on these premises, we classified integration of the acquiring and acquired firms' as the creation of new knowledge developed from referencing knowledge from both the acquiring and acquired firm. Thus, we

discerned whether a newly created patent by the merged firm after the M&A included citations of both prior patents (or a prior patent) created by the acquirer and those (or that) created by the acquired firm. The number of such patents were counted with a 7-year moving window to examine patenting activities within the same span.

3.2.2. Independent Variable

Inventor Retention Ratio. Measuring the inventor retention ratio of the acquired firm is the key operational issue in testing the hypotheses. Among the large body of R&D personnel involved in the technological knowledge functions of a firm, patent creating inventors are those holding crucial knowledge and technological expertise of the firm. These inventors listed in patent documents can be considered inventors critically involved in creating new flows of knowledge within the firm, who are of particular concern in this research context. Thereby, to measure the retention of inventors of the acquired firm we operationalize the extent to which the inventors listed in patents created by the acquired firm before the M&A remain and continue to create patents in the merged firm after the M&A. Marx, Strumsky, and Fleming (2009) operationalize the retention and mobility of inventors through the same measure from patenting activity data of firms. Specifically, we identify inventors who created patents assigned to the acquired firm prior to the M&A deal. Then, we track those potential 'retainable' inventors to examine their future patent

creating activity. In the case which a potential retainable inventor creates a patent assigned in the name of either the acquirer or the acquired firm after the M&A, the inventor is counted as a 'retained inventor'. The ratio of the number of such retained inventors to the number of potential retainable inventors is used to obtain the inventor retention ratio variable. The 7-year moving window is employed in this variable.

3.2.3. Moderation Variables

Relative Size of Acquired Knowledge Base. Patents owned by a firm represent the knowledge that the firm is acknowledged to have created (Jaffe, Trajtenberg and Henderson, 1993). Such patents are naturally the composing elements of a firm's knowledge base (Ahuja & Katila, 2001). Therefore in innovation studies, the size of knowledge bases of a firm is often operationalized as the number of successful patent applications during a certain duration of previous years (e.g., Song & Shin, 2008). Some scholars, however, have pointed out that the simple count of patent applications does not appropriately capture the knowledge size possessed by the firm, since it does not account for the quality of the knowledge. To mitigate this weakness, the number of patents weighted by the number of forward citations is used as a proxy of the size of a firm's knowledge, as has been utilized by studies regarding citations as a measure of the quality of a patent (Trajtenberg, 1990; Puranam & Srikanth, 2007). In this regard, we measure the relative size of the

acquired firm's knowledge base as the number of patents of the acquired firm weighted by the number of forward citations divided by that of the acquiring firm. We set the 7-year moving window prior to the M&A deal, in order to examine patenting activities within the same time span.

Relative Relatedness of Acquired Firm's Knowledge Base. The patents of a firm's knowledge base provide the basis for comparing the firm's knowledge base with other knowledge bases (Ahuja & Katila, 2001). Particularly, to compare the degree of knowledge relatedness between firms' knowledge bases, researches have measured the extent to which the two firms are patenting in the same technological areas (Song, Almeida, & Wu, 2003). Therefore, we measure the relative relatedness of the two firms' knowledge base by using the percentage vectors of subclasses of the patents generated by each firm. Following Jaffe (1986), we use the distribution of the firms' patents over semiconductor or pharmaceutical related patent subclasses to characterize their technological and knowledge positions. Similar to the operationalization of correlation variables, relative relatedness is measured by:

$$\textit{Relative Knowledge Relatedness} = \frac{A \cdot B}{\sqrt{A^2 B^2}} \ ,$$

Where A and B are the percentage vectors of the number of patents in each technology subclass of the acquired and acquiring firms. The 7-year moving window was applied to examine the patenting activities within the same span.

3.2.4. Control Variables

Prior-M&A Knowledge Integration. The level of knowledge integration between the acquired and acquiring firm prior to the M&A deal was included in the empirical test, to eliminate potential selection and endogeneity bias. Acquiring firms may have a higher probability of conducting an M&A deal with a target firm already involved in more knowledge integration, thus resulting in biased results. Further, firm-specific characteristics regarding knowledge integration may affect empirical results. Thus, to test the pure effect of inventor retention after an M&A on post-M&A knowledge integration, the knowledge integration by the acquiring and acquired firms prior to the M&A deal was measured and included in the model. This variable was operationalized with a 7-year moving window prior to the M&A deal.

Post-M&A Co-work. The achievement of knowledge integration is highly affected by the strategic choice and motivations of the acquirer in the M&A deal, of how much integration it strives to pursue. Such strategic choice is manifested by the degree of organizational and physical integration between acquiring and acquired firms after the M&A deal. The degree of organizational and physical integration, strategically chosen by the firms, shapes the outcome of knowledge integration between the merged firms. Specifically, M&A deals with higher level of organizational integration and interaction between the two merged firms would be more likely to face opportunities of knowledge integration regardless of the

retention ratio, thus causing biased results in our empirical analysis. Our research, therefore, counts the number of co-work experience between acquiring firm inventors and the retained inventors of the acquired firm after the M&A deal, as a proxy measure of organizational integration and interaction between the merged firms. Co-work experience is measured with a 7-year moving window after the M&A to examine the same time span as the patenting activities.

Acquirer's Absorptive Capacity. Along with the motivations of acquiring firm's to realize post-M&A knowledge integration between the merged firms, absorptive capacity, the ability of acquiring firms to receive and assimilate the knowledge of the acquired firms may influence subsequent integration of knowledge. Thus, the absorptive capacity of the acquirer is included in the empirical model, to control for potential impacts that such capability of acquiring firms to absorb new knowledge flow from the acquired firm may increase knowledge integration regardless of retention of the acquired firm. Prior M&A literature operationalized the absorptive capacity of firms through measuring the patent diversity of the firm, and our study follows this stream by measuring the acquiring firm's diversity of patents prior to the M&A deal by the Herfindahl index of subclasses of patents as a proxy for acquiring firm absorptive capacity.

Acquirer's ROA. Prior M&A literature used the Return on Assets (ROA) of the acquiring firm as a proxy for financial performance, to account for biases cast on the true effects of various independent variables on post-M&A innovation

performance (Haleblian & Finkelstein, 1999; Makri, Hitt, & Lane, 2010). Search theorists suggest that higher financial performance encourages exploration and efforts for new innovations (Levinthal & March, 1981), increasing subsequent innovation performance. Meanwhile prospect theorists argue the opposite – that higher financial performance induce less exploration (Cyert & March, 1963) – thus, decreasing post-M&A innovation performance. In order to control for possible effects of acquiring firm financial performance on knowledge integration after the M&A, whether it be for the better or for the worse, the ROA of the acquiring firm prior to the M&A deal is calculated from the COMPUSTAT database and included in the empirical model. The ROA of the acquiring firm is operationalized by Net Income divided by Total Assets, as a one-year lagged variable.

Acquirer's R&D Intensity. Higher R&D investments by acquirers can lead to superior innovation outcomes and enhance absorptive capacity from stronger search activities, enabling more successful utilization and integration of acquiring firm's technological knowledge (Cohen & Levinthal, 1990; Cohen, 1995; Ahuja & Katila, 2001). Since such effects of higher R&D investments can bias the association between retention and subsequent knowledge integration, R&D intensity is included in the empirical model. Investment in R&D as a percentage of sales for acquiring firms is calculated from the COMPUSTAT database, as a one-year lagged variable prior to the M&A deal.

Acquirer's Prior M&A experience. Existent studies of M&As have validated that

prior M&A experience of the acquirer has significant influence on subsequent outcomes (Ernst & Vitt, 2000; Haleblian & Finkelstein, 1999). Ernst and Vitt (2000) suggest that if the acquiring firm already possesses experience in handling merger or acquisitions, it can be assumed that the integration of the new firm will be well planned, resulting in more successful integration outcomes. Thus, our study incorporates the acquirer's experience of M&As as a control variable. We measure the natural logarithm of the total number of M&As undertaken by the acquiring firm since year 1981 to the said M&A deal date. The logarithm is used to capture the decreasing marginal returns that experiential learning is subject to (Pablo, 1994; Pennings et al., 1994; Barkema & Schijven, 2008). Similar results were obtained for the non-transformed variable of prior M&A experience.

Post M&A Dummy. The number of additional mergers or acquisitions conducted by the merged firm is included in the empirical model, to account for its effect on innovation performance (Makri et. al, 2010). The number of deals are counted with a 7-year moving window from the M&A deal to examine performance effects within the same span.

Industry Dummy. We account for industry-specific unobserved heterogeneity using an industry dummy. Including this variable in the empirical test controls for the dependence of observations nested within a single industry and eliminates the problem of potential endogeneity bias (Hamilton & Nickerson, 2003). Further, the inclusion of industry dummy captures potential effects of constant industry-

specific factors (Barkema & Schijven 2008), such as higher propensity to integrate knowledge.

3.3. Empirical Method

Negative Binominal Regression Model

Since our dependent variable is a non-negative count variable with over-dispersion, the negative binominal regression model is utilized (Haussman & Griliches, 1984). As an extension of the Poisson regression, the negative binomial model treats the dependent variable as a count variable and is used in cases when the event has extra-Poisson variation in the form of over-dispersion. The negative binominal regression model allows for a direct measure of heterogeneity (Cameron and Trivedi 1986), which not only relaxes the stringent Poisson assumption of equal mean and variance in the error term but also accounts for omitted variable bias. (Walker, Kogut, & Shan, 2007). In our negative binomial models, the probability that the number of knowledge integration will occur n times (with n = 0, 1, 2,...) is as follows:

$$\text{Prob (Y = yj)} = \frac{e^{-\lambda j}\lambda_j^{Yj}}{Y_j!}.$$

Where $\lambda_j = \exp\left(\beta_j X_j + \gamma_j Z_j + \varepsilon\right)$ and $e^{\mu j} \sim \text{Gamma}(1/\alpha, 1/\alpha)$ for observed counts of knowledge integration Y_j, independent covariates X_j, and relevant

control variables Z_j.[1]

4. RESULTS

The descriptive statistics including mean value, standard deviation, and correlations for relevant variables are displayed in Table 1. Examining the correlation matrix, we note that correlations between independent variables do not suggest any palpable concerns about multi-collinearity, as we confirmed by the variance inflation factors of our variables excluding square terms and interaction terms (Neter, Kutner, Nachtsheim, & Wasserman, 1996; Chatterjee, Hadi, & Price, 2000).

The negative binominal regression results for the impact of inventor retention on post-M&A knowledge integration, and subsequent moderation effects are presented in Table 2. In this table, the controls were entered first to represent a baseline model (Model 1), followed by the inclusion of independent variables to test Hypothesis 1 (Model 2), and the moderation terms of relative size of acquired knowledge base and relative relatedness of acquired knowledge base to test Hypothesis 2 and Hypothesis 3 (Model 3 & Model 4).

Consistent with Hypothesis 1, the statistical findings of Model 2 show that the

[1] In the negative binomial model that we specify above, μ_j is an unobserved, omitted variable and $e^{\mu j}$ follows a gamma distribution with mean 1 and variance α as the overdispersion parameter. The larger α is, the greater the overdispersion.

coefficient of the variable *Retention Ratio* is positive and statistically significant ($\beta = 9.50$, $p = 0.00$) and the coefficient of the squared term *Retention Ratio*^{2} is negative and significant ($\beta = -7.87$, $p = 0.00$). The increase of inventor retention ratio positively affects subsequent knowledge integration up to a certain point, beyond which more inventor retention ratio starts to exert negative impact on knowledge integration. These results support our prediction of an inverted-U shaped relationship between inventor retention ratio and knowledge integration between the merged firms, implying the existence of an optimum point of inventor retention. Specifically, the sample data suggests that M&As reach an optimum point of inventor retention at the retention ratio of 40.6%, beyond which the knowledge integration between the merged firms begins to decrease.

Regression results for the moderation effects of relative size of acquired firm knowledge base are significant, verifying Hypothesis 2. Model 3 results show that the coefficient for *Relative Knowledge Size*Retention Ratio* is positive and significant ($\beta = 1.13$, $p = 0.029$), while the coefficient for *Relative Knowledge Size * Retention Ratio*^{2} is negative and significant ($\beta = -2.92$, $p = 0.017$). As aforementioned in our analysis of empirical methods, this indicates to how greater relative size of acquired firm knowledge base amplifies both the positive and the negative effects of inventor retention to knowledge integration, implying the strengthening of the inverted U-shaped relationship by the relative size of acquired knowledge base. As both the positive and negative sides of the inverted U-shaped

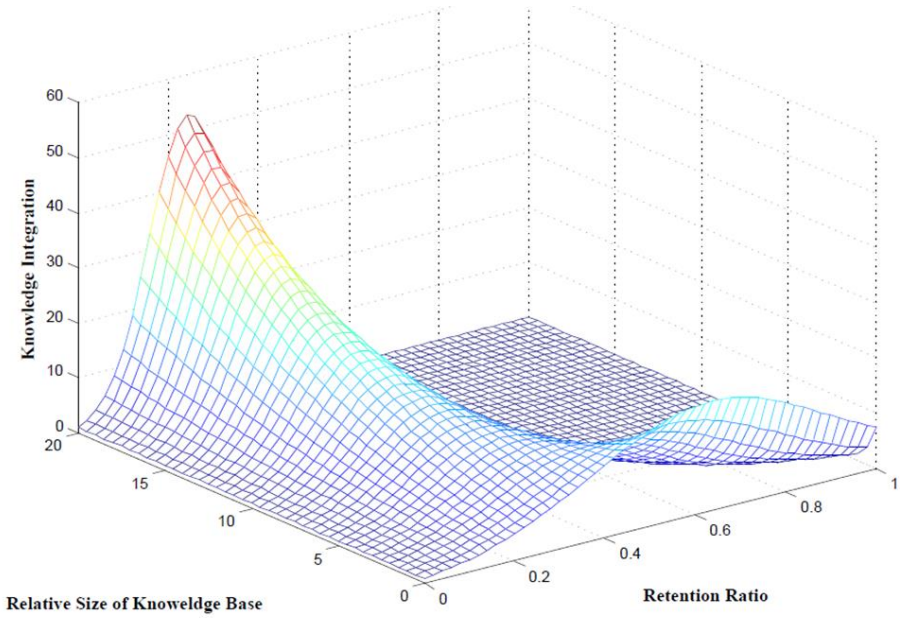
relationship slope steeper, the importance and preference of moderate levels of inventor retention peaks higher. The graphical result of the moderation effect of relative size of acquired firm knowledge base is illustrated in Figure 2, showing the escalation of the optimum point with greater relative size.

Model 4 shows the regression results of moderation effects of relative relatedness of acquired firm knowledge base. Although the results fall short of statistical significance, the coefficient for the interaction term *Relative Knowledge Relatedness*Retention Ratio* is negative (β = -3.85, p=0.535) and the coefficient for the squared interaction term *Relative Knowledge Size * Retention Ratio*^{2} is positive (β = 4.90, p=0.496), implying the weakening effect of the inverted U-shaped relationship by relative knowledge relatedness of the acquired firm. Greater relative relatedness of acquired knowledge base to acquiring knowledge base mitigates both the positive and negative slopes of the inverted U-shaped relationship, diminishing the importance and preference of moderate level of inventor retention. Figure 1 depicts the graphical result of the moderation effect of relative relatedness of acquired firm knowledge base, showing the negative moderation of the optimum point with greater relative relatedness.

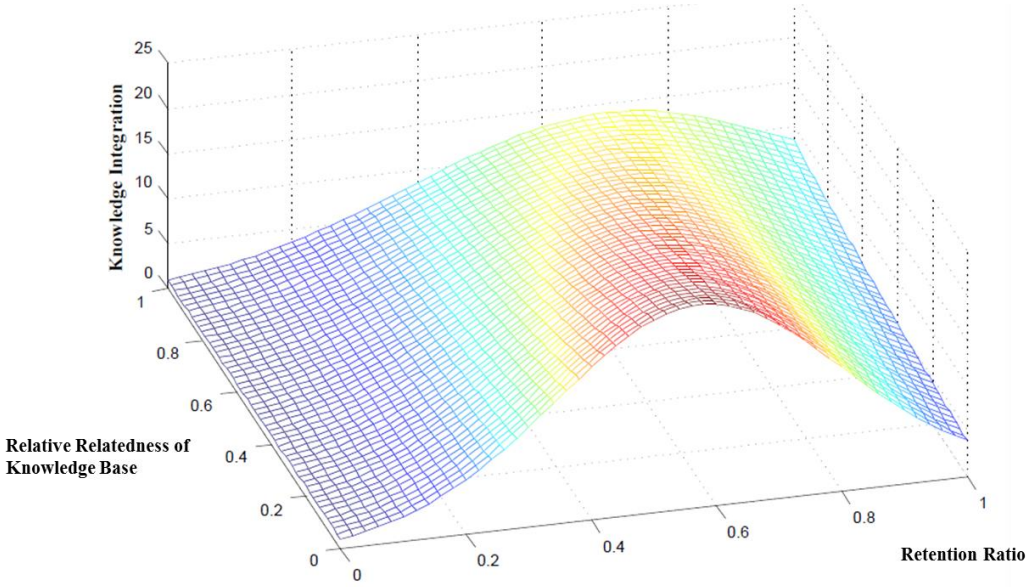
Among control variables, *Prior-M&A Knowledge Integration,* which represents the level of knowledge integration between the acquiring and acquired firms before the implementation of the M&A deal, has a positive and significant association with post-M&A knowledge integration between the merged firms.

Such results could be the consequence of the propensity of acquiring firms to acquire target firms which have already been involved in knowledge integration, or of the merged firm level heterogeneity of tendency to integrate knowledge. *Acquiring Firm ROA(t-1)* and *Acquiring Firm R&D Intensity(t-1),* variables included as a proxy to control for effects that R&D related strategies and motivations of acquiring firms may have on subsequent knowledge integration, had non-significant effects on the dependent variable. The variable *Acquiring Firm Absorptive Capacity*, included in the empirical model to control for the diverse capacity of acquiring firms as recipients of the acquired firm's knowledge, which may shape the subsequent knowledge integration between the merged firms, had non-significant effects. *Post-M&A Co-work*, measured as a proxy of organizational integration efforts between the merged firms, had a non-significant effect on post-M&A knowledge integration. *Prior M&A Experience* variable had a significant positive association with subsequent knowledge integration, suggesting that more merger and acquisition experiences of acquirers facilitate the realization of knowledge integrations between the merged firms. Such results are in line with prior literature that show prior M&A experience positively impact various post-M&A performance outcomes. The *Industry Dummy* shows a significant negative coefficient, implying that M&A deals within the pharmaceutical industry (*Industry Dummy* = 1) are prone to achieve less knowledge integration through M&As compared to the semiconductor industry.

[Figure 2] Moderation Effects of Relative Size of Acquired Firm Knowledge Base



[Figure 3] Moderation Effects of Relative Relatedness of Acquired Firm Knowledge Base



5. DISCUSSION

In extant work, researchers have invariably highlighted the positive side of employee retention after a merger or acquisition, implicitly assuming that an acquired firm's major role stands in providing new knowledge and technological expertise to the acquiring firm. In reality, however, the function of acquired firms of receiving and assimilating knowledge from the acquiring firm holds equal significance in the face of achieving knowledge integration and synergies between the acquiring and acquired firms. Building on the knowledge-based view and the theory of organizational inertia, we have developed a theoretical framework that comprehensively includes both the acquired firm's role as a knowledge provider and a knowledge recipient, rather than only the former function, to understand both the positive and the complementary negative influence inventor retention casts on post-M&A knowledge integration.

Based on a sample of 274 M&As, the results of our study indicate support for our theoretical predictions. Specifically, we found that the contribution of an M&A to subsequent knowledge integration between the merged firms depends on the level of inventor retention. We observed that the level of inventor retention of the acquired firm exerts a positive impact on knowledge integration only up to a certain optimum point, beyond which the dark side of inventor retention unfolds itself to negatively impact subsequent knowledge integration. Moreover, we validated that the relative size of the acquired knowledge base strengthens the curvilinear

relationship between the level of inventor retention and knowledge integration, as to make moderate levels of inventor retention after an M&A more important and preferable. The negative moderating effect of the relative relatedness of the acquired knowledge base on the association between inventor retention and knowledge integration fell short of significance.

5.1. Contributions to Literature

Firstly, our theoretical approach offers a more comprehensive understanding on the acquired firm's role in knowledge integration after a merger or acquisition to the current stream of M&A literature. Whereas nearly all prior research have examined the acquired firm's role as a knowledge provider in the context of an M&A, we argue that the acquired firm's role as a knowledge recipient of the knowledge flow from the acquirer holds equal importance to that as a knowledge provider, in the process of achieving knowledge integration.

Our study also adds richness to the existent literature by shedding light on the dark side of employee retention. Researchers have built on the knowledge-based view and the aforementioned aspect of acquired firms as knowledge providers, and have thus placed scholarly emphasis on the positive effects of employee retention. Such weight on the benefits of employee retention has led scholars to overlook the possible negative impact of employee retention on post-M&A knowledge integration. Thereby, we fill the void of M&A literature by complementing and

extending the analysis centered on the positive effect of employee retention by posing and validating the question of whether too much employee retention from the acquired firm may initiate a negative impact to post-M&A knowledge integration. By incorporating the theory of organizational inertia to explain the negative effect excessive employee retention has on knowledge integration, our study is, to our knowledge, the first to investigate and validate the non-monotonic impact that differing levels of employee retention of acquired firms casts on M&A knowledge integration.

Third, our study centers on the retention of inventors – technological knowledge holding employees – of the acquired firm, expanding the relatively recent stream of retention literature. The majority of prior literature examining the issues of retention after an M&A, particularly strategic management literature, have focused on the retention of top managers and executive employees of the acquired firm. However, as knowledge and technological intensive acquisitions are on the rise, the retention of technological knowledge holding employees is becoming increasingly pivotal in the success of an M&A. Therefore, by examining the retention of technological employees instead of managerial employees, our study keeps in line with reality and contributes to adding on to a recent stream of research, yet to be fully developed.

Lastly, apart from these theoretical contributions, our study may also offer an empirical contribution by formally implementing an empirical analysis on the

retention of inventors and its consequential effects on knowledge integration. Prior research examining the consequences of the retention of inventors (or technological employees) after an M&A have largely utilized qualitative or survey data (e.g. Ranft & Lord, 2002; Ranft, 2006). Our research, which extensively uses quantitative data from USPTO (United States Patent & Trade Office) and COMPUSTAT, offers robust empirical results which may further strengthen and supplement this stream of literature.

5.2. Implications to Managers

We believe that our theoretical framework and empirical results have important practical and insightful implications as well. Most notably, managers should not always regard more employee retention to be auspicious to M&A success. Rather, our study implies that "the more the better" does not apply to employee retention from acquired firms. Such implication to managers suggest that a large portion of corporate strategies and human resource management practices striving for the highest level of retention of employees after an M&A may have to be amended. Real life cases and research studies have shown how firms devote immeasurable expenses to hold on to employees of the acquired firm that are threatening to leave the merged firm. Going back to the case of Millennium Pharmaceuticals and Takeda Pharmaceuticals, Takeda Pharmaceuticals expended both financial and strategic efforts to decrease the turnover rate after the M&A, trying to stop

employees of Millennium Pharmaceuticals from leaving the merged firm. However, our research suggests to managers that strategically aiming for a moderate level of employee retention, in order to achieve both knowledge preservation and prevent organizational inertia, may be the most efficient and desirable approach to attaining knowledge integration.

5.3. Limitations and Suggestions for Further Research

This empirical study has several limitations, which open doors to future studies. Primarily, a limitation of this study that suggests an area of future research is the use of patent data to measure the retention of inventors and subsequent knowledge integration. Although patents are reasonably good indicators of innovative output and are used extensively in management literature, they may not be the perfect measurement of inventor retention and knowledge integration. Particularly, measuring inventor retention by tracking the patent database may bring forth empirical bias of omitting inventors who fail to register patents (Levin et. al, 1987). Although we remedy such potential bias issues by limiting our industry sample to those that have active patenting activity, a more thorough solution may be possible with supplementary employment data of inventors. Investigating the value of knowledge integration with qualitative data, such as in-depth interviews or surveys, would also be a natural extension of the work in this study and would enable a more complete assessment of the contribution of inventor retention on knowledge

integration.

Another limitation of this study lies in the fact that both inventor retention and knowledge integration may be the result of strategic decisions made by the acquiring firm or managers in charge of post-merger integration. In such cases, sample selection issues may arise as the retention of inventors becomes a strategic variable that may have been decided on in order to achieve certain level of knowledge integration. For example, acquiring firms aiming for a certain level of knowledge integration may strategically decide on a certain ratio of inventor retention and further make selections on "who" to retain from the acquired firm. As the retention of inventors becomes a variable strategically decided by managers, the empirical results may become biased. The causal sequence of retention to knowledge integration may become muddled. As a remedial solution, we currently incorporate control variables such as the Post M&A Co-work, to measure the strategic intent of achieving knowledge integration. To strengthen our arguments further, we plan to extend the study by incorporating more rigorous econometric models and control variables. The use of Heckman's two-step selection model along with more control variables such as the individual capability of retained inventors may be helpful in further studies.

Finally, the restriction of the sample to only the pharmaceutical and semiconductor industries cast some limitations to generalizing the results of our study, reinforcing the need for conducting the study in other industries.

Additionally, the relevance and utility of the patent-based measures of retention and knowledge are likely to be limited to industries in which patents are meaningful indicators of innovation. In addition to the two industry sectors examined in this study, further studies could be conducted on other knowledge-intensive industries in which these patent measures could be applied, such as industrial machinery, advanced materials, telecommunication, and robotics industry.

Our study, which highlights complementary perspectives on both the role of acquired firms in an M&A and the effects of post-M&A retention, builds groundwork for the development of future studies. We suggest that a new stream of research may be developed by incorporating the new knowledge receiving role of acquired firms to the extant stream of literature on the knowledge flow and consequences of an M&A. Beyond the issue of retention, the complementary role of acquired firms as knowledge recipients in an M&A may broaden understanding on which target firms to acquire and how to decide on various PMI strategies. Furthermore, as the knowledge providing and knowledge receiving roles of acquired firms have been highlighted in this study, complementing this analysis with the knowledge receiving and providing roles of the *acquiring firm* would complete the investigation on the two knowledge flow mechanism of an M&A. The dynamics of the four roles of the two firms involved in an M&A may be both enlightening and most relevant to reality.

We conclusively suggest that it is important for future research to move beyond

the positive aspects of retention in the context of M&As, and continue to explore the darker sides of retention. One suggestion for future research is to examine other moderating effects on the inverted U relationship of retention of employees and knowledge integration. Factors such as prior relationship or knowledge sharing between the two firms may be an interesting and applicable moderator in this context. Another future extension can be to investigate the movement of the optimum point of retention. Many variable factors can affect the optimal point of retention in an M&A, and such research may have significant implications for both scholarly literature and managers.

6. TABLES

[Table 1] Descriptive Statistics: Means, Standard Deviations, and Correlation Table

Variable	Mean	s.d.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) **Retention Ratio**	0.20	0.28	1.00										
(2) **Relative Size of Knowledge Base**	1.32	10.12	-0.05	1.00									
(3) **Relative Relatedness Of Knowledge Base**	0.21	0.31	0.04	-0.01	1.00								
(4) **Prior-Acquisition Knowledge Integration**	0.83	4.91	0.12	-0.03	0.08	1.00							
(5) **Acquiring Firm Absorptive Capacity**	0.75	0.26	0.09	-0.16	-0.05	0.11	1.00						
(6) **Acquiring Firm ROA(t-1)**	0.00	0.29	0.11	0.00	-0.09	0.07	0.05	1.00					
(7) **Acquiring Firm R&D Intensity(t-1)**	0.78	7.38	-0.04	0.02	0.10	-0.02	-0.11	-0.07	1.00				
(8) **Post- M&A Co-work**	3.10	17.12	0.22	-0.03	0.19	0.28	0.05	0.08	-0.02	1.00			
(9) **Prior M&A Experience**	0.58	0.72	0.11	0.01	-0.01	0.05	0.15	-0.03	-0.07	0.01	1.00		
(10) **Post-M&A M&A Dummy**	0.46	0.60	0.22	-0.07	-0.12	0.07	0.22	0.04	-0.06	0.05	0.26	1.00	
(11) **Industry Dummy**	0.49	0.50	-0.13	0.14	0.29	-0.10	-0.49	0.05	0.08	-0.02	-0.02	-0.25	1.00

[Table 2] Results of Negative Binominal Regression Model [a]
Effects on Post-M&A Knowledge Integration

	Model 1		Model 2		Model 3		Model 4	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Retention Ratio			9.50 ***	1.99	9.29 ***	1.98	10.84 ***	3.27
Retention Ratio^2			-7.87 ***	1.97	-7.23 ***	1.95	-9.48 ***	3.24
Relative Size of Knowledge Base			0.02	0.02	0.01	0.02	0.02	0.02
Relative Knowledge Size * Retention Ratio					1.13 **	0.50		
Relative Knowledge Size * Retention Ratio^2					-2.92 **	1.24		
Relative Relatedness of Knowledge Base			1.59 ***	0.59	1.75 ***	0.57	1.81 **	0.82
Relative Relatedness * Retention Ratio							-3.85	6.21
Relative Relatedness * Retention Ratio^2							4.90	7.20
Prior-M&A Knowledge Integration	0.15*	0.09	0.09 ***	0.03	0.10 ***	0.03	0.10 ***	0.03
Acquiring Firm ROA(t-1)	0.40	0.89	0.11	0.67	0.05	0.65	0.08	0.67
Acquiring Firm R&D Intensity(t-1)	-0.05	0.12	-0.02	0.06	-0.02	0.06	-0.02	0.07
Acquiring Firm Absorptive Capacity	1.44	0.95	1.79	1.10	1.62	1.08	1.75	1.11
Post-M&A Co-work	0.11***	0.03	0.01	0.01	0.01	0.01	0.01	0.01
Prior M&A Experience	-0.86***	0.30	-1.19 ***	0.27	-1.24 ***	0.26	-1.20 ***	0.27
Post-acquisition M&A Dummy	0.54*	0.33	0.46	0.28	0.47 ***	0.28	0.46	0.29
Industry Dummy	-0.39	0.37	-1.13 ***	0.28	-1.11 ***	0.41	-1.09 ***	0.42

a number of observations: 274

* significant at the 0.1 level; ** significant at the 0.05 level; *** significant at the 0.01 level

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국문 초록

지난 연구들은 인수합병 이후에 피인수 기업의 연구개발 종사 직원들을 다수 보유하는 것의 긍정적인 측면을 강조해왔다. 이는 피인수 기업과 그 연구개발 직원들이 인수합병에서 '지식 제공자'의 역할을 맡고 있음에 집중한 것이다. 본 논문에서는 피인수 기업과 그 연구개발 직원들이 인수합병에서 '지식 제공자'로서의 역할뿐 아니라 '지식 수신자'로서의 역할도 동시에 지닌다는 점을 새롭게 조명하며, 인수합병 이후 피인수 기업의 연구개발 종사 직원들이 잔류하는 것의 부정적인 측면을 제시하고자 한다. 이를 보이기 위해 본 연구는 제약 산업과 반도체 산업 인수합병에서 인수 기업과 피인수 기업의 특허 데이터를 면밀히 검토한다. 본 연구는 인수합병 이후에 피인수 기업의 연구개발 종사 직원들의 보유가 어느 정도 수준까지 많아질수록 인수합병 후 피인수 기업과 인수 기업 사이 지식 통합과 시너지 창출에 긍정적 영향을 미치다가, 직원 잔류의 정도가 그 수준을 넘어가면 피인수 기업의 조직적 관성으로 인해 두 기업 사이 지식 통합에 오히려 부정적인 영향을 미치는 것을 보인다. 더 나아가, 피인수 기업의 직원 잔류 정도와 그 이후 피인수 기업과 인수 기업의 지식 통합 정도와의 상관관계가 두 기업 사이 지식의 상대적 크기와 상대적 상관성에 의해 조정될 것을 보인다. 본 논문을 통해 인수합병 이후 피인수 기업 연구개발 종사 직원들의 보유에 대한 새로운 시점을 제시할 수 있다.

주요어 : 인수합병, 지식 통합
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