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MERGERS AND ACQUISITIONS AND CORPORATE INNOVATION

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Abstract

This paper provides both theoretical perspectives and empirical evidence on the relationship between mergers and acquisitions (M&As) and corporate innovation. It also identifies relevant policies implemented by countries around the world to encourage corporate innovation activities, and discusses the experience from which policy makers and practitioners in Asia could learn lessons from. Finally, it makes policy recommendations to promote innovation in both emerging and developed economies in Asia at different stages of development.

Keywords: mergers and acquisitions, corporate innovation, management of corporate innovation, government policy, government regulations

JEL Classification: G34, G38, K20, O31, O32, O38

Contents

1. INTRODUCTION

Technological innovation represents modern corporations' endeavors to develop and accumulate knowledge, and has long been recognized as a catalyst for economic growth and increased productivity (Solow, 1957; Romer, 1986; Aghion and Howitt, 1992), and as a key factor in the competitive advantage of nations (Porter, 1998). This chapter provides both theoretical perspectives and empirical evidence on the relationship between mergers and acquisitions (M&As) and corporate innovation activities. It also identifies relevant policies implemented by countries around the world to encourage corporate innovation activities, and discusses the experience from which policymakers and practitioners in Asia could learn lessons. Finally, it makes policy recommendations to promote innovation in both emerging and developed economies in Asia at their stages of development.

2. THEORETICAL PERSPECTIVES

2.1 Technology and Vertical Integration

There is a vast literature on the determinants of vertical integration. The two leading theories in the field are Williamson's (1975, 1985) transaction cost economics (TCE) and property rights theory (PRT), elaborated by Grossman and Hart (1986) and Hart and Moore (1990). Yet only recently have a number of papers started to examine vertical integration from a technological perspective.

Acemoglu, Griffith, Aghion, and Zilibotti (2010) build a simple model in the spirit of Grossman and Hart (1986) with a focus on the relative importance of technological investments in a bilateral relationship between a producer and a supplier. In the model, the producer and the supplier jointly produce output, and their investment decisions have a specific component in that greater technology intensity leads to a greater possibility of holdup. As standard in the PRT literature, the authors assume that the investments and the output are non-verifiable, and thus non-contractible. The two parties can allocate ownership and therefore control rights over the output. Allocating the control rights to the producer (the customer) will increase its bargaining power *ex post* and induce its investment *ex ante*, but will also reduce the other party's investment. Therefore, control rights are allocated to the producer (customer) if the output depends more on its investment, and the two parties may stay independent if both their efforts are equally important.

The model generates a number of predictions. First, the technological intensities of the producer and the supplier have opposite effects on the likelihood of vertical integration, whereby technology intensity is a proxy for the importance of one party's investment in the final output (empirically, this is measured by research and development [R&D] expenditures divided by total value added). Second, these effects are strengthened when the supplier has a larger share of the input costs of the producer. Third, in the case of backward vertical integration, where the producer acquires the supplier, greater technological intensity of the producer, lower technological intensity of the supplier, and a greater share of input costs of the supplier in the producer's industry make vertical integration more likely. Finally, the outside opportunity of the supplier, as measured by the number of producers in the economy, makes vertical integration less likely.

Using a sample of 46,392 UK manufacturing firms with 20 or more employees over 1996–2001, and using either an indicator variable for whether a firm owns a plant in its supplier industry for a product it produces or a variable measuring the quantity of upstream products produced within a firm as proxies for the degree of backward integration, the authors show that the technological (R&D) intensity of the producing (downstream) industry is associated with more vertical integration, and the technological intensity of the supplying industry is associated with less vertical integration. The correlations between the technological intensities of both the producing and the supplying industries and vertical integration are larger and also more significant when the share of costs of the supplying industry in the total costs of the producing industry is high. Finally, having more firms in the supplying industry reduces the likelihood of vertical integration, while having more firms in the producing industry increases it. To address endogeneity concerns, the authors instrument the technological intensity of every industry in the UK with the technological intensity of its counterpart in the US.

Frésard, Hoberg, and Phillips (2016) develop a simple dynamic incomplete contracting model under the framework of Grossman and Hart (1986) to illustrate the contrasting effects of realized (i.e., patents) and unrealized innovation (i.e., R&D) on the firm integration decision. In the model, there is an upstream supplier and a downstream producer. Both parties cooperate to produce output. The price of the output depends on commercialization and product integration investments made by the downstream firm, and R&D investments made by the upstream firm. The authors further assume that both commercialization and R&D investments are relationship-specific, non-contractible, and non-verifiable. Firms choose the organizational form that minimizes transaction costs and *ex post* holdup. New in their model, the costs and benefits of vertical integration hinge on the stage of the development of innovation, specifically the distinction between unrealized innovation in the form of R&D and realized innovation characterized by legally enforceable patents. The key prediction of their model is that firms are likely to remain separate when their innovation is unrealized and R&D is important; firms are more likely to be integrated when their innovation is realized and is protected by patents.

Using a sample of over 7,000 Compustat firms from 1996 to 2008 and a combination of firms' Securities and Exchange Commission (SEC) 10-K filings and a Bureau of Economic Analysis (BEA) input−output (IO) table to determine vertical relatedness between firm pairs (i.e., supplier−customer pairs), the authors show that firms from industries with more R&D activities are less likely to become targets/acquirers in vertical acquisitions; the opposite is true for non-vertical acquisitions. In contrast, they show that firms from industries with more patents are more likely to become targets/acquirers in vertical acquisitions; the opposite is true for non-vertical acquisitions. These results are consistent with the paper's model prediction that firms with unrealized innovation avoid integration to maintain *ex ante* incentives to invest in intangible assets and keep residual rights of control, while firms in high patenting industries tend to integrate to facilitate commercialization and to reduce *ex post* holdup. To establish causality, the authors instrument an industry's R&D activities with state-level R&D tax credit changes. The idea behind the instrument is that industries with many firms headquartered in states giving out R&D tax credits tend to engage in more R&D activities afterwards.

2.2 M&As as Incentives for Innovation

Phillips and Zhdanov (2013) model how M&A market activity affects firms' innovation incentives and R&D activities. In their model, there is one large firm and at least one small firm. The firms produce differentiated products and engage in Bertrand competition. A firm can decide to conduct R&D, and if it succeeds, the technology can improve demand for its product. The chance of success decreases with the number of firms conducting R&D. When there is an M&A market, one firm can acquire another and apply the latter's technology to all the products in its portfolio. When an acquisition takes place, the surplus for the participating firms arises from both the increase in market power and the combined firm's ability to apply the best technology to all its products.

The model makes the following predictions. First, while an M&A market induces both large and small firms to innovate, its impact is greater for small firms because the possibility of being acquired increases their potential gains from innovation, while large firms may find it optimal to let small firms innovate and acquire successful ones later. Second, large firms are less procyclical in their R&D, while small firms are always more incentivized to innovate with increased demand, and large firms may find it optimal to "outsource" R&D to small firms at an intermediate state of demand. Third, when a small firm has greater bargaining power in M&As, it has a stronger incentive to innovate and the likelihood of acquisition is higher. Fourth, the presence of a larger number of small R&D firms reduces R&D by large firms because the latter have more potential innovators to acquire, while the increased competition reduces the likelihood of success in innovation.

Using a sample of 11,288 Compustat firms with 84,471 firm-year observations from 1984 to 2006, the authors show that a firm's R&D investment responds positively to industry demand (as captured by unexpected changes in demand from downstream industries), to industry acquisition activity (as captured by an industry's M&A activity in the past), and to the probability of being a target. The positive response is smaller for large firms. Both findings are consistent with their model's predictions. To address endogeneity concerns, the authors use unexpected mutual fund flow to estimate the probability of becoming a target. The idea behind the instrument is that unexpected mutual fund flow can exogenously change a firm's valuation and thus its likelihood of being acquired. Finally, the authors show that a firm's R&D activity increases with its expected bargaining power, as captured by merger gains by other target firms in the previous year, and with market competition, and that both effects are smaller for large firms. Again, these findings are consistent with the model predictions.

2.3 Cross-border M&As and Innovation

Guadalupe, Kuzmina, and Thomas (2012) examine how foreign acquirers select target firms and how cross-border M&As incentivize domestic subsidiaries to innovate. The paper first builds a model to study target selection in cross-border M&As and the impact of such acquisitions on corporate innovation. The model features complementarity between a domestic (target) firm's initial productivity and the extent to which foreign techniques via foreign ownership acquisition can improve the firm's production. The model predicts that the more productive the domestic firm, the more likely it will become a cross-border M&A target, and the greater the improvement in techniques the firm will experience after such a merger. In addition, such foreign production technique is scalable. The model further predicts that the larger the market after cross-border M&As due to exporting, the larger the benefit through improvement

in production techniques and the larger the impact the acquisition will have on the domestic target firm's production techniques.

Using a unique panel of 2,800 Spanish firms from 1990 to 2006, the authors show that firms with higher productivity are more likely to become targets in cross-border M&As, consistent with their model's prediction that the complementarity between a firm's initial productivity and the extent to which foreign advanced techniques can improve the firm's production is an important driver for international M&As. Using propensity score matching to study the impact of cross-border M&As on the product and process innovation of domestic subsidiaries, the authors find that cross-border M&As significantly improve the process innovation (i.e., introducing new machines and new methods of organizing production) of domestic target firms, and the impact shows up one year after the acquisition, suggesting a causal impact. Finally, the authors show that cross-border M&As have a significantly stronger impact on domestic subsidiaries' product and process innovation if those subsidiaries export via their foreign parents after the acquisition, consistent with their model prediction that an increase in market access motivates innovation within the domestic target firm.

3. EMPIRICAL EVIDENCE

3.1 General Evidence on M&As and Innovation

Hall's (1988) is one of the first large-sample studies on the relationship between M&As and corporate R&D (without using patent data), and it examines the *ex ante* selection effect of corporate R&D on M&As and the impact of target R&D on the valuation premium at the time of the takeover. The sample comprises 2,519 US manufacturing firms in Compustat between 1976 and 1985, when around 600 of the firms were acquired. Using a logit regression, the author finds that high R&D intensity (i.e., R&D expenditures/sales) is associated with a lower likelihood of becoming acquirers, and is not significantly associated with the likelihood of becoming targets. Matching each acquirer with six randomly drawn firms and using a conditional logit model to study the likelihood of pair formation, the author finds that intra-industry mergers tend to take place between pairs of similar size and with similar R&D intensity, and that the valuation premium at the time of the takeover is positively related to the target firm's R&D stock.

Zhao's (2009) is one of the first large-sample studies to use patent data to examine whether technological innovation drives firms' acquisition decisions and how an acquisition affects technological innovation in subsequent years. Using a sample of 1,053 US M&A deals by public acquirers from 1984 to 1997 and 7,798 industry- and size-matched non-bidding firm-year observations, the author first shows that compared to other firms, bidders tend to have lower innovation quality measured by the number of patent citations (i.e., citation counts) before acquisition, while they have similar innovation quantity measured by the number of patents (i.e., patent counts). Further, bidders are more likely to complete the deal if their citation counts are low, whereas there is no significant relationship between bidder patent counts and the likelihood of deal completion. Finally, using a different matched sample based on a long list of firm characteristics, including sales, market-to-book (M/B) ratio, R&D, profitability, returns, market leverage, and industry, as well as patent counts and citation counts in the year of deal completion, the author shows that after deal completion, formerly less innovative bidders experience significantly greater improvement in patent counts, citation counts, and stock performance compared to non-bidding peers; formerly more innovative bidders do not behave differently after the acquisition compared to

non-bidding peers. Finally, bidders with failed bids have fewer patent counts and citation counts than their peers during the subsequent three years. The author concludes that acquisition could be one way of remedying firms' innovation deficiencies, particularly for less innovative firms. The paper does not differentiate innovation at different stages of development, such as unrealized innovation (i.e., R&D) vs. realized innovation (i.e., patents), nor does it establish a causal relationship between M&As and subsequent innovation outcomes, leaving some gaps for future work in the area to fill.

Bena and Li (2014) is one of the most cited studies examining both the *ex ante* selection effect of corporate innovation activities on merger incidence and pairing, and the *ex post* treatment effect of M&As on corporate innovation activities. Specifically, the authors investigate the following research questions. How are firms' innovation activities related to transaction incidence? Do merger participants possess related technologies prior to the transaction? Does the presence of pre-merger technological overlap affect post-merger innovation output?

To answer these questions, the authors adopt an empirical approach that differs from prior work in a number of ways. First, the authors develop measures of bilateral technology-specific firm characteristics (based on cross-citations of each other's patents and common citations of the same patents) to provide evidence of their importance as drivers of merger pairing at an economy-wide level. Second, by employing different innovation characteristics—innovation output (i.e., patents) and R&D expenses—in their analysis, the authors are able to show such output and expenses have different implications for M&As. Finally, by examining multiple sources of synergy, including technological and product market overlaps, the authors are able to highlight the importance of interactions between multiple core corporate activities for merger pairing.

To study the *ex ante* selection effect of corporate innovation activities on M&A transaction incidence, the authors employ an economy-wide patent−merger dataset from 1984 to 2006, which comprises 2,621 deals with information available on acquirers and 1,762 deals with information available on both acquirers and target firms. To isolate the effect of innovation, the authors match acquirers (targets) to similar firms along key dimensions that affect M&A activities, including industry, year, total assets, and M/B ratio. Based on the matched sample, the authors run a conditional logit regression and find that both acquirers and targets are active in innovations but they have different innovation characteristics. Specifically, acquirers tend to have large patent portfolios and low R&D expenses, while targets tend to have high R&D expenses and slow growth in patents. The results are robust to different matching criteria and suggest that innovation is an important driver of M&A transactions for individual firms.

Using a similar matching and regression specification, the authors further show that when two firms overlap in innovation activities, as captured by the proximity of patent portfolios, shared knowledge bases, and mutual citations of patent portfolios, they are more likely to form merger pairs. Moreover, when two firms also overlap in product markets, as captured by Hoberg and Phillips' (2010) product market relatedness measure, the positive effect of innovation overlap on the likelihood of merger pair formation is reduced. These results suggest that bilateral matching in innovation activities is an important driver of M&A pair formation. They also provide direct evidence that synergies either in technological innovation or product markets are important drivers of M&A deals.

To study the *ex post* treatment effect of a merger on innovation outcome, the authors employ a quasi-natural experiment involving bids withdrawn due to reasons exogenous to the acquirer's and the target's innovation activities. Specifically, the authors match each such bid with a completed M&A deal in the same industry pair, in the same year, and with the closest relative size ratio (i.e., the transaction value to acquirer total assets). The withdrawn bids form the control sample, while the completed deals form the treatment sample. The matching ensures that the treatment and control samples are similar along key dimensions relevant for M&As, i.e., industry composition and time clustering. Using a difference-in-differences specification, the authors show that the combined firm from the completed deals experience significantly less drop in patents compared to the "combined" firms in withdrawn bids, especially if the acquirer and the target overlap in innovation pre-merger. The authors conclude that M&A transactions have a positive causal effect on firm innovation activities.

In work contemporaneous to Bena and Li (2014), Sevilir and Tian (2012) ask the following research questions: How do M&As affect acquirer innovation activities? How do pre-acquisition innovation activities of acquirers and targets affect returns to merger? Using a sample of US public firms from 1990 to 2006, the authors find that a firm's M&A volume is strongly associated with its current and subsequent innovation productivity, as captured by the number of patents and innovation novelty (number of citations per patent). The economic significance of M&A volume for innovations is similar to that of R&D expenses for innovations, suggesting that M&As appear to be at least as important as R&D in contributing to innovation. The authors further show that the association between M&As and post-merger innovations is stronger for mature firms and non-venture capital (VC)-backed firms, suggesting that older firms and non-VC-backed firms that are less efficient in innovations rely more on acquisitions to source innovations from outside. The effect is also stronger if the target and/or the acquirer have higher pre-merger innovation intensity (i.e., past three years' patenting output), suggesting that buying innovative target firms is one way for acquirers to improve their innovation performance. Finally, the authors examine how the pre-merger innovation activities of the target firms affect short- and long-term returns to the acquirers, and find that acquirers experience positive and higher abnormal returns both in the short term (e.g., five days) and in the long term (e.g., five years) after the deal announcement if the target firms are innovative. These results suggest that acquiring innovations is value enhancing both in the short and in the long term.

3.2 The Boundaries of the Firm and Innovation

Do firm boundaries affect corporate innovation activities? Seru (2014) answers this question by studying how the conglomerate form affects the scale and novelty of corporate innovation. Using a sample of 12,090 diversified firm-year observations and 32,018 single-segment firm-year observations from Compustat over the period 1980−1998 and different measures of internal capital market (ICM) intensity (i.e., higher ICM corresponds to a greater degree of mismatch between the inflows and outflows of divisions within a conglomerate), the author first shows that higher ICM intensity is associated with a more severe drop in R&D productivity as measured by the number of citations per patent.

To establish a causal effect of firm boundaries on corporate innovation, the author employs a sample of M&A deals that fail for reasons unrelated to target firm innovation activities, and compares the innovation performance of these firms (i.e., control firms) with that of similar firms that are successfully acquired (i.e., treatment firms). Using a difference-in-differences specification, the author shows that conglomerate M&As

(with acquirers and targets from different industries) significantly reduce innovation, as captured by the number of patents and the number of citations per patent, and the effect is stronger if the conglomerate firm engages in active internal resource allocation. The author conjectures a number of reasons for these findings. One potential reason is that divisional managers who are aware that their innovation outcome might be shared later will reduce R&D effort *ex ante*. Another potential reason is that divisional managers who are concerned about resource allocation by headquarters may continue a project even if the interim information is unfavorable. In either case, the author concludes that the results are consistent with the theory that the conglomerate form stifles innovation.

The author then examines the channel through which the conglomerate form reduces corporate innovation, and finds that the main channel is that incumbent inventors' productivity decreases after the conglomerate merger, while there is a similar level of inventor departure in target firms that are successfully acquired and target firms that are not acquired for exogenous reasons.

Finally, the author finds that after merger, there is no abnormal decrease in the combined firm's valuation and profitability, as captured by the M/B ratio and return on assets. This result holds for unrelated mergers that lead to a significant decrease in innovation performance. To reconcile the decrease in innovation performance with the unchanged firm valuation, the author finds that firms after conglomerate mergers engage in more strategic alliances and joint ventures to maintain their level of innovation output.

Overall, this paper provides a more nuanced view of conglomerate mergers: On the one hand, conglomeration stifles innovation; on the other hand, these firms engage in more innovation activities outside the conglomerate form.

Over the past 20 years, many high-tech firms have significantly expanded their innovative activities, facilitated primarily by the acquisition of new technology. Clearly, the strategic considerations of these technology conglomerates are different from those of traditional conglomerates, the main goal of which is product diversification. Technology conglomerates nowadays do not simply pursue diversification across unrelated technologies, but rather explore technology fields with heated inventive activity. Li, Qiu, and Wang (2017) ask the following research questions: How to measure the extent to which an innovative firm is a technology conglomerate? Besides mergers and acquisitions (M&As), do technology conglomerates also use strategic alliances, arguably a more common strategy than M&As for innovative firms to gain access to new technology? Do strategic alliances facilitate technology conglomerates' innovative activities and, if so, how?

To answer these questions, the authors propose a novel measure, firm-to-economy technological proximity, to capture the extent of technology conglomeration for innovative firms. This new construct is a cosine similarity measure between a firm's own patent output, measured by the number of patents across different technology classes, and the patent output of all other firms in the economy. In essence, it captures three basic features of technology conglomerates: (a) producing innovations, (b) producing innovations in multiple technological fields, and more importantly, (c) exploring technological fields with heated inventive activity.

With this new measure, the authors start by examining whether technology conglomerates form strategic alliances more frequently and find that technology conglomerates are more likely to form alliances. When increasing the measure of firm-to-economy technological proximity by one standard deviation, a technology conglomerate's number of alliances formed per year increases by 5.6%. The results

suggest that strategic alliance is an important organizational form for technology conglomerates to access new technology.

A technology conglomerate is likely to explore not only different technological fields, but also different product markets. In a similar vein, such exploration in product markets might also incentivize the firm to form alliances. To shed light on this possibility, the authors control for product market exploration as captured by Hoberg, Phillips, and Prabhala's (2014) product market fluidity measure in explaining alliance formation. They find that both variables are positively and significantly associated with the number of alliance deals, suggesting that in exploration in technological fields and in product markets there are distinctly different driving forces behind firms redrawing their boundaries.

The authors also examine the choices between alliances and M&As for technology conglomerates and first show that technology conglomerates also do more deals, consistent with anecdotal evidence provided earlier in the introduction and the findings of Phillips and Zhdanov (2013) and Bena and Li (2014), which show that M&As play a significant role in facilitating technological innovation. The authors further find that conditional on either forming alliances or making deals, technological proximity between a firm pair leads the two firms to choose acquisitions over alliances, supporting the theory of complementarity-driven M&As (Rhodes-Kropf and Robinson, 2008; Bena and Li, 2014). This analysis suggests that technology conglomerates access new technology through either alliances or M&As, and that closer technological proximity between a firm pair leads to full integration through M&As.

Finally, using a treatment regression with an instrumental variable that captures the incentives of a firm forming an alliance based on state-level tax rules, the authors find that after alliance formation, the innovation output of alliance firms is significantly improved, especially for technology conglomerates. In contrast, there is no positive effect of a firm's exploration in product markets on its post-alliance innovation output. In particular, the post-alliance patents of a technology conglomerate provide more backward citations to the pre-alliance existing knowledge of the other partner in the same alliance, and a technology conglomerate produces more patents in its partner's technology classes, suggesting knowledge spillovers and cross-fertilization. The authors conclude that alliances are another effective means of high-tech firms gaining access to and developing new technologies.

3.3 Anti-takeover Laws/Provisions and Innovation

Atanassov (2013) examines how strong corporate governance, proxied by the threat of hostile takeovers, affects innovation (in terms of patent quantity and quality) and firm value. For identification, the author relies on staggering the enactment of the state-level Business Combination Law to proxy for the exogenous decline in the threat of hostile takeovers. Using a panel of over 13,000 US firms over the period 1976−2006 and a difference-in-differences specification, the author finds that firms incorporated in states that passed the Business Combination Law innovate less (in terms of both patent and citation counts) than similar firms incorporated in states without such a law. In terms of the economic significance of the effect, the author shows that four years after the passage of the law, an average firm in a state enacting the law experienced a 21% reduction in the number of citations per patent compared to a similar firm in a state not passing the law. Moreover, most of the effect on innovation shows up two or more years after the law was passed, suggesting that the effect is causal.

To shed light on the mechanism underlying the relationship between corporate governance and innovation, the author shows that the negative impact of state-level anti-takeover laws becomes smaller for firms with a blockholder or an activist pension fund to monitor, or if the firm has high leverage or faces more intense competition in the product market. Nonetheless, the author further shows that these alternative corporate governance mechanisms cannot completely substitute the role of hostile takeovers in fostering corporate innovation as they mitigate but do not eliminate the negative impact of anti-takeover laws on corporate innovation. The author concludes that his findings are consistent with the hypothesis that the takeover threat reduces the moral hazard of managers, keeping them focused on pursuing innovative and valuable projects.

Sapra, Subramanian, and Subramanian (2014) theoretically and empirically study the relationship between external governance in the form of takeovers and corporate innovation. In their two-period model, the manager of a firm chooses to invest in one of two projects: a more innovative project or a less innovative project. The payoffs of both projects are uncertain and occur at the end of the second period. The more innovative project has a higher mean quality, but heavier tails in its posterior distribution than those of the less innovative project. At the end of the first period, the firm could be acquired by a raider if the intermediate signal is sufficiently poor, so the posterior assessment of the quality of the firm's project is below a certain threshold. If the firm is taken over, the manager loses the control benefits.

Their model generates a number of predictions. When the takeover pressure is low, the small likelihood of a takeover implies that the expected takeover premium and the expected loss of control benefits are insignificant for both projects. The manager will choose the more innovative project as it has a higher expected payoff. When the takeover pressure is high, the considerable likelihood of a takeover implies that the expected takeover premium and the expected loss in control benefits are both high. Moreover, at a high level of takeover pressure, the takeover probabilities are similar for both projects, as is the expected loss of control benefits. However, the expected takeover premium will be higher for the more innovative project as it depends not only on the probability of a takeover but also on the size of the takeover premium conditional on a takeover. As a result, it is again optimal for the manager to choose the more innovative project when the takeover pressure is high. Finally, when the takeover pressure is moderate, the expected loss of control benefits dominates the expected takeover premium; the manager will thus choose the less innovative project. In brief, their model predicts a U-shaped relation between the level of corporate innovation and the level of external takeover pressure.

To test their model's key prediction, the authors employ a sample of 44,674 firm-year observations with data on the number of patents and citations from 1980 to 1995. Using panel regressions with firm and year fixed effects and a difference-in-differences specification, the authors show that corporate innovation, as captured by R&D/sales (i.e., a measure of *ex-ante* innovation), number of patents per dollar of R&D, and number of citations per dollar of R&D (i.e., two measures of *ex-post* innovation), increases when the state-level anti-takeover index is low and when the state-level anti-takeover index is high, consistent with their theory. The state-level index of anti-takeover laws compiled by Bebchuk and Cohen (2003) is the proxy for takeover pressure. The index assigns to each state a score from 0 to 5 that is equal to the number of antitakeover statutes passed by the state.

Unlike the two papers reviewed above, Chemmanur and Tian (2016) empirically examine whether and how firm-level corporate governance mechanisms such as anti-takeover provisions (ATPs) that insulate managers from threats of hostile takeovers help address the tension between pressures from short-term public markets and long-term innovation activities that contribute to the long-term value of a firm.

For identification, the authors compare innovations of firms that pass shareholder voting to reduce the number of ATPs with slightly more than 50% of the votes and innovations of firms that fail to pass shareholder voting with slightly less than 50% of the votes. As such, within the narrow band around the 50% threshold, passing or failing to reduce ATPs constitutes (locally) *random* events that are unrelated to a firm's observable and unobservable characteristics. This is an ideal setting for employing a regression discontinuity design (RDD) to help establish the causal effect of ATPs on corporate innovation as measured by the number of patents and the number of citations per patent.

Using data from RiskMetrics on shareholder proposals from 1997 to 2006, the authors identify a "close call" sample of 233 proposals with the percentage of votes on ATPs falling within a 10% range centered around the 50% cutoff. The authors find that reducing ATPs leads to fewer patents and citations per patent, suggesting that firm-level ATPs help promote both innovation quantity and quality. The authors conclude that their results support the view that ATPs can insulate corporate managers from the short-term pressure of the public market, and without the worry of losing control in the short term, managers are incentivized to engage in more corporate innovation activities. Importantly, this paper provides a more nuanced view regarding the role of takeover laws/provisions in corporate innovation: At the state level, Atanassov (2013) finds that state-level anti-takeover law reduces firm innovation activities; at the firm level, ATPs promote innovation. Thus, it is important to be aware that state-level and firm-level anti-takeover measures have distinctively different effects on corporate innovation.

3.4 M&As and Innovation: Industry- and Country-Level Evidence

Ahuja and Katila (2001) study the effect of acquisitions on the subsequent innovation performance of acquiring firms in the chemicals industry. Using a sample of 534 acquisitions made by a sample of 72 leading firms (30 European, 26 American, and 16 Japanese) from the global chemistry industry over the period 1980−1991, the authors search news stories and US patent databases to determine whether a particular deal is a technological acquisition or not. To measure the size of the knowledge base of a firm, the authors use the number of cited and obtained unique patents. To measure the relatedness between an acquirer's and a target's knowledge base, the authors use the ratio of the number of unique commonly cited and obtained patents between the two companies over the size of the acquirer's knowledge base. To measure the performance of a firm's innovation effort, the authors use patent counts.

Using a pre-sample number of patents in the baseline logit regression to control for unobserved firm level heterogeneity and generalized estimation equations to control for unobserved correlation between observations, the authors find that non-technological acquisitions have no significant impact on the acquirer's subsequent innovation performance. Moreover, the absolute size of the target firm's knowledge base increases the acquirer's subsequent innovations, and the relative size of the target's knowledge base reduces the subsequent innovation performance of the acquirer. Finally, the authors show that there is an inverted-U shaped relationship between the

technological relatedness of acquirers and targets, and the subsequent innovation output of the acquirers. The authors conclude that when the characteristics of acquisitions are accounted for, acquisitions improve the technological performance of the acquiring firm. Moreover, the inverted-U shaped relationship between the technological relatedness of acquirers and targets and innovation output suggests that in choosing takeover targets, acquirer management should avoid either target firms that are only distantly related or target firms that are too closely related to the technological capacities of the acquirer.

Cassiman and Veugelers (2006) examine the complementarity between different innovation activities—internal R&D and external knowledge acquisition—and factors that affect such complementarity. Using a sample of 269 Belgian innovation-active manufacturing firms in 1993, the authors first classify a firm's innovation activities as "buy" innovations only, "make" innovations only, "make and buy," and "no make and buy," where "buy" is defined as gaining knowledge from licensing, contracting for technology or technology advice, and M&As. Innovation performance in this study is measured as the percentage of sales from new products. By running a regression of a firm's innovation performance on the four indicator variables of firm innovation activities (e.g., "buy" and "make"), the authors find that the sum of coefficients on "buy and make" and "no make and buy" is greater than the sum of coefficients on "buy" and "make," suggesting complementarity between internal knowledge creation and external knowledge acquisition.

The authors then examine what factors affect a firm's choice of innovation activities using a multinomial logit model, and find a strong role of reliance on basic R&D affecting the complementarity between internal and external knowledge acquisition. Moreover, the authors show that the "effectiveness of strategic protection," a variable proxying the ease of using secrecy, lead time, or product or process complexity to protect innovation, is positively associated with both "buy" and "make" innovation activities, suggesting that this is an important contextual factor in enhancing complementarity between internal and external knowledge acquisition. The authors conclude that success in innovation depends not only on combining various innovation activities ranging from "buy" only, "make" only, or a combination of both activities, but also on creating the right context in which to enhance the complementarity across various innovation activities, leading to sustainable competitive advantage.

Higgins and Rodriguez (2006) study how corporate innovation drives M&As and how M&As in turn affect corporate innovation. Using a sample of 160 transactions from 15 countries in the pharmaceutical industry over the period 1994−2001, the authors first develop a new industry-specific measure, the desperation index, to capture the current status of a firm's internal productivity. Specifically, the index is based on the sales-weighted exclusivity horizon (i.e., the exclusivity profile of a product and sales of products over the lifecycle of the exclusivity horizon to produce a sales-weighted exclusivity horizon), and a score that captures the clinical probability at each phase of the research stage of a potential treatment receiving FDA approval.

Using a probit regression, the authors show that firms that are more desperate or suffer from a decline in research productivity are more likely to engage in acquisitions to strengthen their research pipelines. Using an event study, the authors show that even acquiring firms at higher levels of desperation are able to extract substantial gains from making acquisitions. Importantly, the authors find that pre-merger information-gathering activities, such as previous alliance activities with the target, and prior research experience and sales experience in the target firm's innovation domain, are positively and significantly associated with acquirer announcement period returns.

Hsu, Huang, Humphery-Jenner, and Powell (2013) examine whether cross-border M&As are used to pursue innovation opportunities outside acquirers' own countries. Using a sample of 85,549 deals from 57 countries over the period 1990−2010, the authors measure firm-level innovation by R&D intensity (R&D/total assets) and patent counts, country-level innovation by the natural log of the number of patent applications, the number of patent applications scaled by a country's GDP, and the number of patent applications scaled by a country's population.

The authors first show that country-level innovation is negatively and significantly related to the likelihood of a firm doing a cross-border deal, consistent with the idea that acquirers from high-innovation countries have less need to acquire innovation overseas. In contrast, innovative acquirers are more likely to do a cross-border deal if they are from a low-innovation country, especially to buy targets that have higher innovation than themselves, suggesting that these firms use cross-border deals to acquire innovation capacity. Results based on acquirer announcement period returns further show that innovative firms from low-innovation countries gain more from cross-border deals than from domestic deals. The authors conclude that the acquisition of innovation is an important and value-enhancing driver of cross-border M&As.

Stiebale (2016) studies the impact of cross-border M&As on the innovation activities of the merged entity, the acquirer, and the target firm. Using a sample of 229,479 firm-year observations on 62,511 European firms and 941 M&A deals over the period 1997−2008 by matching firm financials from the Amadeus database with M&A information from the Zephyr database, the author shows that cross-border M&A deals are associated with increases in post-merger innovation activities of the combined firms and the acquirers, and a decrease in innovation activities of the target firms. Innovation activities are measured by the number of patents, the number of citation-adjusted patents, and R&D expenditures. Moreover, the author shows that the positive effect of cross-border M&As on innovation increases with both the acquirer's and the target's pre-merger patent stock, suggesting that access to complementary firm-specific assets matters for cross-border M&As. Finally, decomposing the effect of cross-border M&As on innovation by inventors' countries, the author finds that the positive effect is driven by innovation generated in the country of the acquirer's headquarters, while there is on average a substantial decrease in innovation generated in the country of the target's headquarters, suggesting that cross-border M&As are accompanied by a relocation of innovative activities across subsidiaries and countries.

To establish the causal effect of cross-border M&As on firms' innovation activities, the author employs two approaches. First, the author uses propensity score matching to match combined firms/acquirers/targets (i.e., treatment firms) with similar firms not engaging in any cross-border M&As (i.e., control firms), and a difference-in-differences specification to compare the innovation activities of the treatment firms with control firms before and after the deals. Second, the author uses changes in a country's accounting standards to estimate firms' likelihood of being involved in a cross-border M&A. The idea behind the instrument is that changing accounting standards affects the information asymmetry between firms from the event country where accounting standards have changed and firms from other countries, thereby affecting the likelihood of firms from the event country being involved in cross-border M&A deals.

3.5 M&As and Innovation: Emerging Economic Evidence

Sun (2014) studies the impact of acquired technology on the innovation performance of Chinese firms. Using a sample of 108 technological acquisitions made by publicly-listed firms in the People's Republic of China over the period 2001−2008, where an acquisition is identified as technology-driven if the acquirer claimed technology to be a motivation for the acquisition, if technology was a part of the transferred resources, or if the target engaged in any patenting activity in the five years prior to the acquisition, the author shows that the average growth ratio of acquirers in patent applications over the five-year period post-merger is 10.664, while the national average growth ratio in patent applications is 1.649, and the difference between the two is statistically significant.

The author further shows that there is significant improvement in the average growth ratio of acquirers in patent applications over the five-year period post-merger compared to that in the five-year period pre-merger. Using a Poisson regression and 108 technology-driven acquisitions, the author shows that the absolute size of the target's knowledge base (as measured by the number of patents over the five-year period pre-merger) positively affects post-merger innovation performance, while the relative size of the target's knowledge base (normalized by the acquirer's knowledge base) negatively affects post-acquisition innovation performance. Using an interaction term between the acquirer's pre-merger intangible assets and the absolute size of the target's technology base to capture the acquirer's absorptive capacity, the author finds that the acquirer's absorptive capacity does not have any positive impact on the relationship between the target's technology base and the acquirer's innovation performance. The author concludes that firms should not only pin their hopes on "purchased technologies," but also need to improve their own absorptive capabilities.

Vyas and Narayanan (2016) ask if M&As matter for R&D using evidence from the pharmaceutical sector in India. Employing a panel data set of 171 pharmaceutical firms over the period 2000−2010 and 134 M&A deals over the period 2000−2007 and propensity score matching to match each acquirer with similar firms based on the lagged value of acquirers' economic and innovation characteristics, the authors find that M&As are associated with significantly lower post-merger R&D intensity (i.e., R&D expenditures/net sales).

The importing of technology is measured in two ways. Direct importing of capital goods is called "embodied technology importing," while indirect importing at arm's length through the payment of royalties and lump sum fees is called "disembodied technology importing." Embodied technological intensity (ETI) is the ratio of expenditures on imports of capital goods to net sales. Disembodied technology intensity (DTI) is the ratio of lump sum, royalty, and technical fee payments in foreign currency to net sales.

The authors show that acquirers' disembodied technology imports significantly reduce their in-house R&D intensity over the three-year period post-merger, while acquirers' embodied technology imports enhance their in-house R&D intensity, but with a significant effect only in the third year post-merger. The authors interpret their findings as suggesting that disembodied technology imports are substitute to technology acquired through M&As and reduce organic R&D investments in post-merger years, while embodied technology imports are complementary to technology acquired through M&As and further enhance organic R&D investments post-merger. Finally, the authors show that the relatedness of acquirers and targets as captured by a horizontal acquisition indicator variable has a positive and significant impact on the acquirer's R&D intensity in the third-year post-merger, as well as on the average R&D intensity

over the three-year period post-merger. The authors interpret their findings as suggesting that immediate post-merger years are consumed by the restructuring and integration of target and acquirer firms, and hence the improvement in acquirer's R&D intensity only shows up three years later.

4. LESSONS LEARNT AND POLICY IMPLICATIONS

4.1 Broad Lessons Learnt and Policy Implications

The evidence from the US and around the world is loud and clear, namely that M&As can be used to outsource corporate R&D and to strengthen a firm's innovation effort as long as there is great complementarity between organic innovation and acquired innovation. On the other hand, there are some well-known pitfalls associated with doing deals: 1) overbidding for the target firm, (2) selecting the wrong target firm, and (3) failing the post-acquisition integration process.

To strengthen the positive effect of M&As on the post-merger innovation performance of acquirers, aspiring acquirers need to pay attention to the following dimensions:

- Familiarity breeds success. One of the key concerns for an acquirer is its ability to value the target firm accurately. Firms that attempt to make acquisitions outside their core competencies could have difficulty adding value to the firm. Given this potential challenge, it makes sense for knowledge-intensive firms to pursue targets with similar competencies. One effective way to do so is to engage in some pre-acquisition information gathering, besides normal corporate due diligence, to reduce the degree of information asymmetry between the acquirer and the target firm. For example, an acquirer could consider making an alliance or undertaking joint venture with a prospective target firm. These activities function as a feedback mechanism, which allows prospect acquirers to generate information on a potential target and effectively avoid overpayment and selecting the wrong target.
- Maintain own research competence. Having own research pipelines and competence provides acquirers with a number of advantages in the M&A process. Own research competence strengthens the acquirer's bargaining position against the target, avoiding overpayment. In addition, own research competence also allows the acquirer to assess the target's technological portfolio correctly and to identify synergies. With own research competence, the acquirer has the absorptive capacity that eases the integration process post-merger.
- Search for complementarity in innovation portfolios. There are a number of benefits associated with acquirers and targets sharing technological competencies. First, given that intellectual property and technological knowhow, by their very nature, are more difficult to evaluate than tangible assets, one challenge for an acquirer is its ability to value a target firm accurately. If the acquirer and the target firm are familiar with each other's technologies, information asymmetry between the merger participants is mitigated. Second, by reducing duplication in R&D efforts—which also triggers mergers—technological overlap can lead to economies of scale and scope in innovation. Finally, with similar technologies, it is possible that one merger partner's technology may fill gaps in the other's patent portfolio, resulting in

the post-merger firm experiencing strengthened innovation prowess or more competitive positioning.

- Retain and incentivize target employees. One of the biggest challenges in technology-driven M&As is that acquirers need to retain and incentivize the target firm's employees, who represent a significant portion of the firm's value. One way of doing so is to grant target employees equity ownership in the combined company so that they care about the combined firm, stay committed to ongoing projects, and are incentivized to contribute to ensuring good post-merger performance instead of shirking or quitting.

4.2 Lessons and Policy Implications for Developing Countries

The evidence from developing countries on the relationship between M&As and corporate innovation is limited. Based on studies from the People's Republic of China and India, we can draw a number of lessons for countries and firms interested in promoting corporate innovation.

- Firms in developing countries are increasingly using M&As, both cross-border and domestic, to acquire, absorb, utilize, and explore advanced technologies around the world.
- For technology-driven acquisitions to be successful, it is vital for developing country acquirers to possess the necessary absorptive capacity. In the management theory literature, absorptive capacity involves four stages: acquisition, assimilation, transfer, and utilization (Zahra and George, 2002), and is typically measured by the prior knowledge base (i.e., patent counts prior to the deal), the intensity of R&D effort, or the science and technology level of acquirers. As such, government and firm policies promoting science and technology development will help make technology-driven acquisitions a success.
- Given that developing country firms typically do not have the infrastructure to absorb target firms' technology capacities effectively, the relatively large size of the knowledge base gained by the acquirer may disrupt the acquirer's existing innovative activities and make integration more complex, more time-consuming and uncertain. It is thus recommended that the relative size of the acquired knowledge base should not be so large that it leads to subsequent integration challenges.
- On the other hand, the absolute size of the acquired knowledge base (i.e., patent counts) increases acquirers' technological input and the possibility of changing acquirers' organizational routines and creating new organizational mechanisms, and is shown to be positively associated with post-merger acquirer innovation performance. It is thus recommended that developing country acquirers should pursue acquisition targets with a large absolute knowledge base.
- For developing country acquirers, it is important to be aware that purchased technology is a panacea, but they should focus on building up their own absorptive capacities, a combination of their own knowledge base, and science and technology development.

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