

# Antecedents of Successful IT M&As

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## Abstract

In this paper, I examine the antecedents of successful IT M&As. Drawing from several theories from strategic management, I propose several hypotheses about the impact of acquiring firm's environmental uncertainty, pairwise technology complementarity, product market proximity, and the acquiring firm's CEO narcissism on combined firm's post-M&A performance measured by profitability and innovation capability. Empirical results partially support my hypotheses: I find that technological complementarity is positively correlated with both post-merger profitability and innovation capability. CEO narcissism, on the hand, only impacts the profitability measure and there is an inversed U-shape relationship. I also find the positive interaction effect between CEO narcissism and technological complementarity on profitability.

**Keywords:** M&A, environmental uncertainty, product market proximity, technological complementarity, CEO narcissism, post-M&A performance

## 1. Introduction

Merger and Acquisition (M&A) has been an extensively studied phenomenon in economics, finance, accounting, and strategic management in the past several decades. Early empirical studies by financial economists typically suggest that M&A did not enhance acquiring firm's value (Haleblian et al., 2009) as measured mostly by short term performance measure of market reaction. Alternative performance measures such as longer-term accounting-based and non-financial performance measures were also used, and findings have been mixed. In the recent decade, more attention has been put to the study of motivation of M&A and the antecedents of successful M&As using a variety of performance measures. Even though M&A is not a new topic, little attention has been focused on M&As among IT industry. Over the past 15 years, the technology industry has experienced a high volume of M&A activity. In fact, technology M&A has exceeded any other industry, largely fueled by a constant demand for innovation and a decade-long period of consolidation (PwC – US Technology M&A Insights). Therefore, it is important and valuable to completely understand the motivations and outcomes of IT M&As in a rigorous research design. More importantly, the context specific variables might provide new insights and findings that are different from what we know about M&A in the existing literature. Therefore, in this study, I intend to examine M&As among information technology (IT) industry. Specifically, I plan to study the following research questions: What are the antecedents of successful IT M&As?

The alternation of IT firm boundaries can be explained by economic theories including transaction cost economics (TCE), strategic management theory on complementarities. Moreover, upper echelon theory suggests that CEO has the determining power in those M&A decisions, and I am also interested in the question of how CEO's narcissistic behavior or overconfidence may play a role in M&A performance. I am interested in studying M&A performance hypotheses built based on those theories. Specifically, I study the associations between firms' post-M&A performance with (1) environmental uncertainty, (2) technological complementarity between acquiring and targeted firm, (3) product market proximity between acquiring and targeted firm, and (4) direct effect of CEO narcissism and its interaction effects with above relationships. I think this study will at least make three contributions: (1) Even though there has been significant amount of studies on M&A performance in finance, strategic management literature, most of them consider characteristics of the acquiring firm, relatedness of acquiring and target firms, and deal level covariates, this study will be the first one which examines how the acquiring firms' environmental antecedents impact post-merger performance. Previous studies argue that firms operate in uncertain environment are more likely to vertically integrate rather than acquiring inputs and services from the market to avoid high transaction cost of using market exchanges. Therefore, I argue that if there is a "fit" between firm's environmental characteristics and its governance mechanism, the mechanism should be more

effective. (2) Also, although the context of many M&A researches is high tech industry such as pharmaceutical and biotechnology, almost none of them studies the M&As exclusively on IT firms. As IT advances in the past two decades, there are increasing numbers of high tech firms start and will remain relying on IT for purposes of product/service innovation and/or efficiency improvement. Thus, it is increasingly important and valuable to study the determinants of success acquisitions of IT firms for those high-tech firms who want to vertically integrate some of their IT functionalities, either for efficiency enhancement or increased innovativeness in product market. Focusing just on IT M&A might yield some different findings and interesting insights that are unique to IT M&As. (3) In addition to those main predictors, this study is almost the first one which investigates the effect of psychological trait of firm's CEO on M&A performance.

The rest of the paper is structured like this: section 2 discusses the hypotheses development and theories behind them. In section 3, I will discuss the empirical method including sampling, variable definitions and econometrics models. Section 4 presents empirical results and their implications. The paper is concluded in section 5 with the discussion of contribution and managerial implications.

## 2. Hypotheses Development

The alternation of IT firm boundaries can be explained by economic theories including transaction cost economics (TCE) and strategic management theory on complementarities. Moreover, product market similarity is also an important predictor for M&A performance in the literature. I am interested in studying M&A performance hypotheses built based on those theories, while also focusing on aspects of this phenomenon that are specific to IT M&A. Specifically, I study the associations between acquiring firms' post-M&A performance with (1) acquirer's environmental uncertainty, (2) technological complementarity between acquiring and targeted firm, and (3) product market proximity between acquiring and targeted firm. I consider both financial performance and innovation performance as dependent variables.

### 2.1 Environmental Uncertainty

Even though M&A performance and its ex ante factors have been extensively studied in various fields during the past several decades, most of them focus on the characteristics of acquiring firm and the deal level covariates. Previous studies overlook the firm's fundamental motivation of M&A, and there has yet been any reported finding on how those motivations impact the performance of M&A ultimately. In other words, there might be some reasons for firms to choose to acquire an external firm instead of using alternative governance mechanisms with it, however we overlook these reasons and are not clear if firm made the right decision in the first place. M&A is one of the governance mechanisms for firms to acquire inputs, knowledge and technical know-how, while there exist other alternatives such as using market to buy, or contracting services to external vendors, or building alliances or equity joint ventures with other firms. Originating from influential works of Coase (1937) and Williamson (1975, 1985), transaction cost economics (TCE) theory has been proposed to explain the firm governance mechanism choice and extensively examined in its empirical studies. Neoclassical economics suggests that market is more efficient because of economies of scale or scope, while TCE argues that governance choice is also determined by the transaction cost of using markets such as the costs of search, negotiating, writing and enforcing contracts, and monitoring partners in the contractual relationships (Williamson, 1975). A fundamental axiom of transaction cost economics is that the firm boundaries are determined the trade-off between transaction cost of using markets and governance and production costs using hierarchies. TCE especially emphasizes on the importance of the cost associated with the governing and monitoring transactions of using markets (Leiblein & Miller, 2003). In some circumstances, the cost of governing and monitoring increases significantly and surpasses the efficiency gains provided by market exchanges. In his three-factor paradigm, Williamson (1985) suggests that frequency, uncertainty, and asset specificity are critical factors that drive up cost of using markets and make internal governance more attractive. The fundamental logic is that high degree of uncertainty and asset specificity result in highly complex contractual environment and greater need for adjustments to be made after the relationship has begun and commitments have been made (Holmström & Roberts, 1998). However, in hierarchies, firms have control over both sides of transactions, thus have less problem in potential disputes. In the context of this study, the focal firms who made M&As are high tech firms which seek IT knowledge base or technical know-how for either product development, expansion of product market or innovation capability enhancement. As discussed earlier, innovation seeking high-tech firms also have the choice of using market exchange, vertical integration through M&A, and engaging in strategic alliance to acquire assets and knowledge from external entities. Hagedoorn & Duysters (2002) argue that when making choice between M&A and strategic alliances as source of external innovation capabilities, firms have different preferences based on firm specific circumstances such as whether they are high tech firms or not and whether the innovation is related to their core business, but the decision is also made based on the environment in which they

operate. Uncertainty in the surrounding environment of innovation-seeking high-tech firms is an important factor to consider when making IT boundary choices.

Uncertainty refers to the degree to which unanticipated environmental change that might alter the conditions underlying an exchange. For example, an unexpected environmental change in a focal firm's industry may increase the number of contingencies of its contractual relationship with external service or product providers and make it costlier to write and enforce contingencies. Thus, firms which operate in a more uncertain environment are more likely to choose vertical integration or internal governance mechanism in acquiring inputs or knowledge. In the strategic management and organization theory literatures, environmental uncertainty has been conceptualized and studied quite thoroughly. Dess & Beard (1984) test several indicators in their factor analysis and conclude three dimensions of dynamisms, munificence, and complexity to be the indicators of the composite measure of environmental uncertainty. More specifically, dynamism represents the volatilities and unpredictability of changes in the business environment that a firm has to deal with (Keats & Hitt, 1988; Xue, Ray, & Gu, 2011; Xue, Ray, & Sambamurthy, 2012). For example, the industry is said to be highly dynamic, thus uncertain, if the sales volume or profitability is volatile and unpredictable over the years. As another indicator of uncertainty, munificence refers to the industry growth (Dess & Beard, 1984). The industries that are experiencing high rate of growth in demand or income are considered as those with high munificence. Munificence also increases firm's uncertainty because it tends to adopt strategies and structures that can help them capture these growth opportunities (Xue, Ray, & Gu, 2011). Complexity is the number and heterogeneity of task-environment elements in the industry in which a firm operates. In other words, firms find the industry highly complex if they are competing with more competitors or the industry is not concentrated or dominated by some big players. Firms find their industries to be very uncertain if they have high complexity because the entry of new players and/or turnover of existing competitors could be more frequent and unpredictable. The logic is that, in my quasi-experiment setting, there is variation in acquiring firm's industry environment. When it comes to IT knowledge acquisition, based on my argument earlier, those firms who face uncertain environment should have used hierarchy mechanism versus market exchanges or hybrid governance. Therefore, I expect that among those acquisitions that already happened, the acquiring firms in more uncertain environment will outperform their counterparts who should have not acquired because of their relatively stable environment. Therefore, my first set of hypotheses is:

**Hypothesis 1A:** Ceteris paribus, acquiring firm's pre-merger industry dynamism is positively associated with its post-merger performance.

**Hypothesis 1B:** Ceteris paribus, acquiring firm's pre-merger industry munificence is positively associated with its post-merger performance.

**Hypothesis 1C:** Ceteris paribus, acquiring firm's pre-merger industry complexity is positively associated with its post-merger performance.

## 2.2 Technological Complementarities

Relatedness between acquiring and target firm has been a commonly studied antecedent of M&A performance, and technological relatedness has been identified as an important predictor of post-merger innovation performance, especially for high-tech M&As. Ahuja & Katila (2001) find that the relatedness of acquired and acquiring knowledge base has a nonlinear impact on performance in terms of innovation output, and similar finding has been reported by Cloudt, Hagedoorn, & Van Kranenburg (2006) when they find that there is an inverted U-shape relationship between technological relatedness and post-merger innovation performance. These findings suggest that if the acquiring firm's technological knowledge bases are too different from those of target firm, the combined firm will not perform well in innovation after the merger. However, the innovation performance is also low when it goes to another extreme – being so related will in turn harm the innovativeness of the merged firm. M&As that integrate highly similar technology narrow the range of potential learning and also reduce the incentives to explore divergent research opportunities available from M&A (Makri, Hitt, & Lane, 2010). Cassiman et al. (2005) find that firms are more likely to reduce R&D efforts, and emphasize on the development over research when they acquire targets with more similar technologies than when they acquire targets with more complementary technologies. Therefore, acquiring firms would like to find a target firm which possesses technological knowledge base that is somewhat similar to theirs, but not too much similar because the optimum is that the target firm's knowledge base can provide new capability or know-how beyond their existing knowledge base for product/service innovation. I can call it "complementarity" in technological knowledge. The idea of complementarity is originally defined as "doing one of more thing increases the return to doing another" in economics by Milgrom & Roberts (1995). In the strategy literature, complementarity is an important construct

in the resource-based view (RBV) of the firm (e.g. Barney, 1991; Wernerfelt, 1984), where it has been depicted as mutual reinforcing assets, capabilities, and technology. Complementarity has been extensively studied as many of the areas in strategy field such as diversification (e.g. Harrison, Hall, & Nargundkar, 1993), strategic alliance (e.g. Gulati, Nohria, & Zaheer, 2000), and R&D (e.g. Cassiman & Veugelers, 2006). In the context of M&A, complementarity is still underexplored. In a recent study by Finkelstein (2009), they examined the impact of strategic and marketing complementarity on acquisition performance, where they define acquisition complementarity as occurring when merging firms have difference resources, capabilities, and/or strategies that can potentially combined or reconfigured to create value that did not exist in either firm before the acquisition. Their empirical findings suggest that complementarity is an important antecedent of acquisition performance. There also exists complementarity of technological knowledge base between the acquiring firms and target firms. In a case study of 31 individual M&As, Cassiman et al. (2005) find that M&A partners with ex ante complementary technologies result in more active R&D performers after the M&A, suggesting that technological complementarity may lead to higher level of innovation in the merged firm than others who has lower level of complementarity. Makri, Hitt, & Lane (2010) provided empirical evidences showing that in technical M&As, complementary scientific and technological knowledge both contribute to post-merger invention performance by stimulating higher quality and more novel inventions. In this paper, M&As between acquiring firms and IT firms are essentially technological mergers as well, thus I follow the previous studies and propose a similar hypothesis:

**Hypothesis 2:** Ceteris paribus, technological complementarity between acquiring firm and target firm is positively associated with post-merger performance of the combined firm.

### *2.3 Product Market Proximity*

M&A has been argued to be more successful when the acquiring firm and the target firm are similar. The similarity in terms of resource, technology, and strategy between bidding firm and acquired firm is assumed to be positively correlated with post-merger performance by some researchers such as Prahalad & Bettis (1986), and empirical evidences have been found in later studies (e.g. Singh and Montgomery, 1987). Datta (1991) investigates the impact of organizational differences between acquiring and acquired firm on post-merger performance based on 173 M&As in U.S. manufacturing industry and result indicates that difference in management style is negatively correlated with post-merger performance for M&As characterized by both high and low levels of integrations. Similarly, Ramaswamy (1997) examines the impact of strategic similarities between target and bidder firms in U.S. banking industry on changes in post-merger performance and finds that mergers between banks exhibiting similar strategic characteristics result in better performance than those involving strategically dissimilar counterparts. On the other hand, some researchers suggest the opposite theoretical argument that uniquely value synergy might be created where differences (versus similarities) exist between resources in the acquiring and target firms (Harrison et al., 1991), where they find its positive impact on accounting performance when exploring synergies in resources allocations. Even though similarity between the bidding firm and acquired firm has been extensively studied, little of them focus on the similarity between their product market segments. Therefore, I will examine this question in this study. I follow the debates in the literature and think the same debate can also exist in product market similarity. On one hand, firms who have similar product lines are assumed to share common knowledge base and processes, thus the merger and acquisition requires less effort of integration and coordination, so an acquisition between a bidding firm and a target firm which has overlapped product lines may create more value for the acquiring firm. However, I can also argue that too much similarity in product market will hamper the performance of M&A because there is less unique knowledge, process, and know-how can be taken from the target firm to enrich acquiring firm's product lines, or in other words, there is less synergy could be created out from the merger. Therefore, the impact of product market relatedness of the acquiring and target firm is ambiguous, so I propose the following two competing hypotheses:

**Hypothesis 3:** Ceteris paribus, product market similarity between acquiring firm and target firm is positively associated with post-merger performance of the combined firm.

**Hypothesis 3 (competing):** Ceteris paribus, product market similarity between acquiring firm and target firm is negatively associated with post-merger performance of the combined firm.

### *2.4 CEO Narcissism*

Literature has suggested that CEO narcissism is positively related to firms' highly visible initiatives such as acquisitions. Malmendier & Tate (2008) find that the odds of making an acquisition are 65% higher if the CEO is overconfident. Chattejee & Hambrick (2007) also find that CEO narcissism is positively correlated with number

of size of acquisitions. However, the literature has yet reported any study which investigates the effect of CEO narcissism on firm's M&A success. Thus, I am interested in how CEO narcissism/overconfidence impacts the M&A performance directly and/or through moderating effect with other determinants in the model. As one of the proxy Chatterjee & Hambrick (2007) use in their study, I measure CEO narcissism as her relative compensation compared to the company's second highest paid executive. It is also consistent with the finding by O'Reilly et al. (2014) that narcissism CEO have more money in their total shareholding and have larger discrepancies between their own compensation and those of the others in the top management team. To make the model simple, I combine both cash-based compensation and equity-based compensation. As for the direction of the impact of CEO narcissism on acquisition performance, it is a two-fold story. On one hand, I argue that more narcissistic CEO has more ability and ambition to make M&A work and perform better than their counterparts, thus CEO narcissism is positively related with post-merger performance. On the other hand, narcissistic CEOs will be too aggressive and over rate their ability (and probably ignore others' opinions) to harness M&A gains (Gerster et al., 2013). Therefore, I propose a set of competing hypotheses:

**Hypothesis 4:** Ceteris paribus, CEO narcissism is positively associated with post-merger performance of the combined firm.

**Hypothesis 4 (competing):** Ceteris paribus, CEO narcissism is negatively associated with post-merger performance of the combined firm.

### 3. Research Methodology

#### 3.1 Data

I test the hypotheses using a sample data of 477 M&As completed during 1990 to 2013. M&A deals with detailed information are obtained from Thomson One database. In order to be included in my sample, the acquiring firm should be in the technology intensive industry and acquired firm should be in the "IT industry" (SIC 357, 737, and 5045). Following the previous studies (Finkelstein and Halebian, 2002; Makri, Hitt, and Lane, 2010), I only include those deals with transaction value of over ten million dollars because firms tend to adopt a hands-off approach with small acquisitions as their effects are likely to be negligible. Also, both acquirer and targeted firm need to be publicly traded firms in the United States because I need their annual financial data to calculate some of the independent variables and outcome variables. I start with 7,387 M&A deals announced from 1990 – 2013 with purchase price of at least ten million dollars. After applying the industry filter as discussed earlier, I narrow the sample size to 3,121. Further limitation to just public firm make us end up with 552 M&A deals before excluding deals that are essentially shares buyback. I also match the M&A sample with annual financial data such as revenue, net income, and return on asset (ROA) in Compustat database, and exclude those deals that miss the financial data for all three years prior to the M&A announcement. The final sample of 477 deals consist of 264 initiated by acquirers in software, computer-related services and data processing industry (SIC – 737), 120 from computer, computer peripheral equipment, and storage devices industry (SIC – 357), 29 from instruments, photographic, search and navigation equipment industry (SIC – 38), 28 from semiconductors and related devices industry (SIC – 367), 21 from telephone and communication equipment (SIC – 366), 4 from pharmaceutical and biological products industry (SIC – 283) and remaining acquiring firms are in some other high technology industries. All target firms are IT-related firms such as computer and hardware manufacturers, software and IT service vendors (SIC - 357, 737, and 5045).

#### 3.2 Variable Definition and Operationalization

##### 3.2.1 Industry Level Measures

I measure the industry level characteristics using industry sales data. Munificence is measured as the industry sales growth. I run a regression of industry sales on year indices for the past five years and use the coefficient of the regression as the proxy of the industry sales growth. Similarly, I run regressions of industry sales on year index and take the standard error as the proxy of volatility of industry sales to measure dynamism. Lastly, for industry complexity, I calculate the Herfindahl index of industry market shares as a measure of industry concentration.

##### 3.2.2 Product Market Proximity

Following Bloom et al. (2013), I use the *COMPUSTAT* sales segments data to calculate the product market proximity for each pair of acquirer and target firm. For each firm, I collect the sales revenue in each of four-digit SIC industries and create a vector of sales distribution. For each pair, I calculate the cosine similarity measure which ranges from 0 to 1. Higher value in that similarity indicates higher overlap between acquirer's and target's product market.

### 3.2.3 Technological Complementarity

As for the technological complementarity measure, I collect patent application data from the *U.S. Patent and Trademark Office*. For each firm in my sample, I collect the number patents successfully applied in each year of observation and the associated category information. Patents are categorized to different classes and subcategories. I measure the technology complementarity of the acquirer and the target by taking the average number of acquiring and target firms' patents in the same subcategory but in different patent classes. If two firms apply patents in completely different categories or in exactly the same class, those two firms are either too different or too similar in terms of technological know-how and capability, which means they do not complement each other. My measure very well captures the degree to which both firms are complementarities.

### 3.2.4 CEO Narcissism

I use the CEO compensation data as the proxy of CEO narcissism because based on Chatterjee & Hambrick (2007), CEO relative compensation compared to his or her TMT team is one of the aspects to measure narcissism. I collect the CEO compensation data from the *COMPUSTAT Execucomp* database. I take the ratio of the CEO's compensation to the firm's second highest paid executive's cash pay to calculate the relative pay of the CEO.

### 3.2.5 Control Variables

Following the previous literature, I control for the acquirer's size, relative size, prior performance, CEO age, and CEO gender in the model because they are the confounding factors that might impact the dependent variables. Firm size is captured by the number of employees, prior performance is measured by return on assets (ROA), and other CEO characteristics are self-explanatory.

### 3.2.6 Dependent Variables

There are two dependent variables of interest to measure the post-merger performance of the acquiring firm. First, I use the industry-adjusted revenue weighted ROA at t+1 to measure the profitability of the combined firm. On the innovation side, I use the number of patents acquiring firm filed (and eventually granted) at t+1 where t+1 is the year after the acquisition year.

Table 1. Variable Definitions

Variable	Definition/Operationalization
Industry Sales Growth (Munificence)	Growth of industry sales (coefficient of a regression of industry sales on year index for the past five years)
Industry Sales Volatility (Dynamism)	Volatility of industry sales (standard error of a regression of industry sales on year index for the past five years)
Industry Concentration (Complexity)	Herfindahl index of industry market shares
Product Market Proximity	Average uncentered correlation between firms paring vector of share of sales of firm in the 4-digit SIC industry
Technological Complementarity	Average number of acquiring and target firms' patents in the same subcategory but in different patent classes
CEO Narcissism	Average ratio of CEO's compensation and firm's second highest paid executive's cash comp
Post-merger Performance	Innovation
Post-merger ROA	Numbers of patents acquiring firm filed (and eventually granted) at year t+n (n=1, 2) ROA at year t+n (n=1, 2)

## 4. Results

### 4.1 Effect on Profitability

I conduct regression analyses of return on assets (ROA) on controls and variables of interests. In Table 2, I report the results ROA at t+1. Column 1 shows the regressions results of OLS model with only control variables included. Prior ROA, acquirer's size and CEO tenure are found to be positively correlated with the ROA after the M&A deal. In Column 2, I add the main independent variables in the model, and only environment dynamism (industry sales volatility) is positively correlated with the dependent variable (0.041,  $p < 0.01$ ). I find the positive relationships between environment complexity, technological complementarity, and CEO narcissism and ROA, but they are not statistically significant at 5% level. Since I do not much of linear relationships, I test the curvilinear relationships. In model 3, I include the quadratic terms of product market proximity, and CEO narcissism and find different results. The reason I test the squared terms of proximity and CEO narcissism is because both of them tend to harm the organization if we go to extremes. Overly similar product market coverage between the acquirer and the target firm might decrease the value of the M&A deal since there is little complementarity whereas companies with too different product offerings may also not benefit a lot from the

acquisition. Moderate level of product market proximity, in turn, might be the best for the M&A to create value. Similarly, I speculate that acquirer needs a somehow (but not too) narcissistic CEO to make the deal work the best. Therefore, I also hypothesize inversed U-shape relationships between those two characteristics and the outcome variable. The coefficient of PMP squared still stays insignificant, so does the PMP itself. However, I find that the coefficient of technological complementarity (0.212,  $p < 0.01$ ) which indicates that acquirer-target pair who has higher level of technological complementarity tends to have higher performance in profitability as a combined company after one year of merge. More interestingly, I find the positive relationship between CEO narcissism and post-M&A performance (0.07,  $p < 0.05$ ) and negative coefficient on the quadratic term of CEO narcissism (-0.013,  $p < 0.01$ ) suggesting the inversed U-shape relationship, as I hypothesized. Model 3 shows better estimations as the adjusted  $R^2$  is increased from 12% to 19% compared with base model. The last column of Table 2 presents additional finding about the interaction effect between CEO narcissism and technological complementarity. The reason why I propose this hypothesis is because CEO usually has much involvement in the re-structuring process for the combined firm. A CEO with higher ability (thus more narcissistic and higher pay) tends to better leverage the complementarity and make higher profit after one year of integration. Therefore, I suggest that there is positive interaction effect between those two variables. Not surprisingly, I find that the coefficient of that interaction term is positive (0.077,  $p < 0.05$ ), which is consistent with my hypothesis.

Table 3 presents the results of regression analyses of ROA two years after the M&A on the same set of predictors. Across all models, control variables on CEO characteristics include age and tenure are found to have positive impact on the ROA. For main variables of interest, I still do not find much evidence on the impact of environmental uncertainty on profitability. Among them, I only find positive impact of industry dynamism, but the results are not significant at 5%. Munificence is found to have negative impact on the ROA, but the results are also not very significant. Product market proximity between the acquirer and target has a surprisingly negative impact on ROA, which is contrary to the hypothesis. This is consistent with the finding in Table 2. I still find positive and significant relationship between technological complementarity and ROA at  $t+2$ . This results consistently show up in model 3 and model 4 where curvilinear and interaction terms are included, and  $R$  squared is higher. This finding suggests that technological complementarity is vital to acquirer's profitability even after two years of the acquisition. Recall that there is inversed U-shaped relationship between CEO narcissism ROA, however I do not find such relationship in the model of ROA at  $t+2$ . Though I do not find main effect of CEO narcissism, I still find the positive interaction effect of that with technological complementarity (0.29,  $p < 0.05$ ).

#### 4.2 Effect on Innovation Performance

In addition to profitability, I also examine the innovation capability measured by numbers of patents acquiring firm filed (and eventually granted) at year  $t+1$  and  $t+2$ . Since number of patents is a count variable, I use negative binomial model to estimate. Table 4 presents the regression results of number of patent applied (and eventually granted) at  $t+1$ . None of the main independent variables has significant estimated coefficients except for technological complementarity (2.77,  $p < 0.01$ ). I also test the model for  $t+2$  and find similar results.

### 5. Conclusions

In this paper, I examine the antecedents of successful IT M&As. Drawing from several theories from strategic management, I propose several hypotheses about the impact of acquiring firm's environmental uncertainty, pairwise technology complementarity, product market proximity, and the acquiring firm's CEO narcissism. Dependent variables of interests include profitability and innovation capability after one or two years of M&As. The empirical analyses generally do not support my hypotheses on environmental uncertainty such that I do not find evidence that acquirers operate in more uncertain environment tend to perform better in after M&As. Product market proximity also does not seem to be related to post-M&A performance of the combined firm. However, I do find that technological complementarity between acquiring and target firm is vital to the success of acquisitions. In models of profitability and innovation capability, I find positive effects of technology complementarity. CEO narcissism, however, has only been found to have positive impact on profitability, and more interestingly, there is an inversed U-shaped relationship. Taken together, those findings suggest that environmental characteristics are not as important as technological "fit" between acquirer and target and CEO ability is not always helpful to make the deal work. Also, similarity or proximity of product market is not necessarily important to post-M&A performances.

My hypotheses are partially supported. Hypotheses 1 are not supported based on the empirical testings. Hypothesis 2 regarding technological complementarity is strongly supported as I find consistent significant and positive relationships between it and dependent variables in different forms. Regarding Hypothesis 3 on product

market similarity, I have a set of competing hypotheses. It seems that the empirical testing favors the argument that too similar product market hurts the M&A performance in terms of ROA, but no support is found for patent-based performance measure. For the last hypothesis about CEO narcissism, I also have a set of competing hypotheses. Empirical testing supports that CEO narcissism is favorable for ROA at t+1, and surprisingly, on top of the main effect, I found non-linear relationships (inverted U-shaped) indicating that too little or too much CEO narcissism is hurting, which is somehow consistent with my original competing hypotheses.

Table 2. Regression Analysis of Return on Assets (t+1)

Accounting Performance	DV: ROA (t+1)			
	OLS Null Model	OLS Base Model	OLS Curvilinear	OLS Curvilinear Interactions
Intercept	-0.335 (-2.26)**	-0.72 (-3.89)***	-0.659 (-1.76)†	-0.643 (-1.77)† 0.596
Prior ROA	0.598 (3.87)***	0.636 (3.71)***	0.602 (3.24)***	(3.25)*** 0.0006
Acquirer Size	0.001 (1.71)*	0.000 (0.76)	0.0004 (7.1)***	(3.78)*** 5.78e-06
Relative Size	2.79e-06 (0.26)	7.02e-06 (0.64)	5.74e-06 (1.76)†	(1.75)†
CEO Age	0.005 (1.54)	0.007 (2.02)**	0.006 (1.49)	0.007 (1.52)
CEO Tenure	0.005 (1.8)*	0.006 (1.81)*	0.005 (2.52)**	0.005 (2.7)**
Industry Sales Growth (Munificence)		0.007 (0.82)	0.005 (0.96)	0.005 (0.91)
Industry Sales Volatility (Dynamism)		0.041 (2.6)***	0.04 (1.71)	0.041 (1.71)
Industry Sales Concentration (Complexity)		0.000 (1.81)*	0.000 (2.04)*	0.000 (2.07)*
Product Market Proximity		-0.005 (-0.09)	-0.118 (-1.1)	<b>-0.229 (-1.79)*</b>
Product Market Proximity <sup>2</sup>			0.111 (0.88)	0.109 (0.93)
Technological Complementarity (TC)		0.237 (1.26)	<b>0.212 (2.78)***</b>	<b>0.206 (2.78)***</b>
CEO Relative Compensation		0.041 (1.49)	<b>0.07 (2.48)**</b>	<b>0.043 (3.69)***</b>
CEO Relative Compensation <sup>2</sup>			<b>-0.013 (-6.37)***</b>	<b>-0.013 (-6.06)***</b>
CEO Relative Compensation * TC				<b>0.077 (2.54)**</b>
<b>Observation</b>	342	303	301	301
<b>F-Ratio</b>	5.41***	4.31		
<b>Adjusted R<sup>2</sup></b>	0.07	0.12	0.19	0.19

*Robust standard errors are adjusted for 14 clusters in industry. t scores are in the parentheses.*

*\*, \*\*, \*\*\* indicates that  $p < 0.1$ ,  $p < 0.05$ , and  $p < 0.01$ , respectively. † means the coefficient is marginally significant.*

Table 3. Regression Analysis of Return on Assets (t+2)

Accounting Performance	DV: ROA (t+2)			
	OLS Null Model	OLS Base Model	OLS Curvilinear	OLS Curvilinear Interactions
Intercept	-0.847 (-2.96)***	-1.326 (-3.51)***	-1.317 (-2.31)**	-1.257 (-2.38)**
Prior ROA	0.041 (0.14)	-0.031 (-0.09)	-0.024 (-0.17)	-0.039 (-0.26)
Acquirer Size	0.000 (0.61)	0.000 (0.07)	3.1e-06 (0.01)	0.0005 (2.67)**
Relative Size	4.01e-06 (0.2)	9.38e-06 (0.44)	8.21e-06 (1.58)	8.31e-06 (1.58)
CEO Age	0.014 (2.4)**	0.016 (2.27)**	0.016 (2.33)**	0.018 (2.34)**
CEO Tenure	0.009 (1.59)	0.011 (1.66)*	(3.07)***	0.01 (3.42)***
Industry Sales Growth (Munificence)		-0.011 (-0.65)	-0.012 (-1.8)*	-0.012 (-1.92)*
Industry Sales Volatility (Dynamism)		0.064 (1.96)**	0.059 (1.81)*	0.062 (1.82)*
Industry Sales Concentration (Complexity)		0.000 (0.85)	0.000 (1.4)	0.000 (1.55)
Product Market Proximity		0.02 (0.18)	0.136 (1.25)	<b>-0.277</b> (-2.2)**
Product Market Proximity <sup>2</sup>			-0.135 (-1.13)	-0.149 (-0.79)
Technological Complementarity (TC)		0.303 (0.79)	<b>0.273 (2.82)**</b>	<b>0.244 (2.58)**</b>
CEO Relative Compensation		0.083 (1.53)	0.083 (1.87)*	-0.015 (-0.55)
CEO Relative Compensation <sup>2</sup>			-0.002 (-1.23)	-0.003 (-1.38)
CEO Relative Compensation * TC				<b>0.29 (2.74)**</b>
<b>Observation</b>	324	289	287	287
<b>F-Ratio</b>	2.17**	1.79**		
<b>Adjusted R<sup>2</sup></b>	0.02	0.03	0.07	0.09

*Robust standard errors are adjusted for 14 clusters in industry. t scores are in the parentheses.*  
 \*, \*\*, \*\*\* indicates that  $p < 0.1$ ,  $p < 0.05$ , and  $p < 0.01$ , respectively. † means the coefficient is marginally significant.

Table 4. Regression Analysis of Innovation Performance (t+1)

Innovation Performance	DV: Patent (t+1)			
	Negative Binomial Null Model	Negative Binomial Base Model	Negative Binomial Curvilinear	Negative Binomial Curvilinear Interactions
Intercept	1.939 (2.04)**	-0.254 (-0.19)	-0.402 (-0.19)	-0.324 (-0.14)
Prior ROA	5.102 (4.77)***	5.572 (4.87)***	5.92 (6.27)***	5.968 (6.33)***
Acquirer Size	0.006 (0.97)	0.001 (0.11)	0.001 (0.29)	0.002 (0.41)
Relative Size	0.000 (0.45)	0.000 (0.49)	0.000 (1.13)	0.000 (1.13)
Prior Average Patent	0.003 (4.6)***	0.003 (4.27)***	0.003 (1.95)**	0.003 (1.88)*
Prior R&D Intensity	0.933 (1.89)*	1.216 (2.26)**	1.493 (2.54)***	1.506 (2.59)***
CEO Age	0.021 (1.12)	0.058 (2.45)**	0.059 (2.48)***	0.062 (3.1)***
CEO Tenure	0.023 (1.13)	0.024 (1.08)	0.022 (1.71)*	0.019 (2.09)**
Industry Sales Growth (Munificence)		-0.013 (-0.26)	-0.014 (-0.47)	-0.007 (-0.3)
Industry Sales Volatility (Dynamism)		-0.17 (-1.65)*	-0.162 (-1.3)	-0.168 (-1.41)
Industry Sales Concentration (Complexity)		0.000 (0.63)	0.000 (0.75)	0.000 (0.91)
Product Market Proximity		0.478 (1.21)	1.111 (1.01)	0.58 (0.37)
Product Market Proximity <sup>2</sup>			-0.64 (-0.52)	-0.555 (-0.47)
Technological Complementarity (TC)		<b>2.786 (1.96)**</b>	<b>2.806 (2.54)***</b>	<b>2.77 (2.4)***</b>
CEO Relative Compensation		0.014 (0.07)	0.065 (0.67)	-0.079 (-0.37)
CEO Relative Compensation <sup>2</sup>			-0.017 (-0.77)	-0.016 (-0.58)
CEO Relative Compensation * TC				0.296 (0.56)
<b>Observation</b>	355	314	312	312
<b>Log Pseudo-likelihood</b>	-1530.647	-1363.413	-1357.933	-1357.652
<b>Over-dispersion Alpha</b>	1.6e+05***	1.3e+05***		

*Robust standard errors are adjusted for 14 clusters in industry. z scores are in the parentheses.*  
 \*, \*\*, \*\*\* indicates that  $p < 0.1$ ,  $p < 0.05$ , and  $p < 0.01$ , respectively. † means the coefficient is marginally significant.

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