



ESSAYS ON MERGERS & ACQUISITIONS AND INNOVATION

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ESSAYS ON MERGERS & ACQUISITIONS AND INNOVATION

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ESSAYS ON MERGERS AND ACQUISITIONS

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While innovation and growth can be promoted internally through focus on research and development (R&D), many firms find acquisition from external sources to be a speedy and attractive alternative. Despite the numerous theories of merger and acquisition (M&A) in the literature, no empirical study has tackled the problem of target selection in an acquisition. The existing studies on M&A outcomes also fail to control for the endogenous matching between the acquirer and the target.

Essay 1 of this dissertation is the first to study the target selection criteria in an empirical setting. It quantifies the elusive concept of synergy by developing new measures of similarity and complementarity between the acquirer and the target that are more comprehensive than the existing measures in the literature. Using an innovative application of the discrete choice model, I find that firms use acquisition to promote growth and innovation in areas of strategic interest. Specifically, acquirers choose target firms whose product markets match their own R&D projects, and target firms whose R&D projects match their own product markets.

Essay 2 enriches the modeling approach for merger partner selection in essay 1. I use a game-theoretic matching model and study the impact of matching on merger performance. With a Bayesian estimation method, I apply the model to 1895 mergers in five high-tech industries that occurred between 1992 and 2008. I find that the unobserved strategic fit between the two merging partners has a significant effect on the post-merger innovation abilities of the combined firm. Managers wisely choose merger partners that deepen their technical knowledge, but under-estimate the

challenges in integrating foreign partners and partners with similar technology. I also find evidence of estimation bias due to matching induced endogeneity.

Essay 3 of the dissertation is a comprehensive review of the M&A related research published in top marketing journals. This review will provide marketing scholars with a research background on M&A, both in terms of theories and marketing applications of those theories. This review will help readers to appreciate the contribution made by marketing researchers to M&A knowledge, and hopefully inspire more marketing scholars to incorporate M&A topic in their research.

BIOGRAPHICAL SKETCH

Yu Yu was born in Changchun, China and received her early education in her hometown. She received her Bachelor's Degree in Finance from Nan Kai University in Tianjin, China in 2002 before she came to the United States. She spent two years in the Economics PhD program in Indiana University-Bloomington and moved to Ithaca, New York to pursue her doctoral studies in Marketing at Cornell.

I dedicate this dissertation to my husband and my parents

谨以此论文献给我的父母和先生

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CHAPTER 1

PROMOTING GROWTH AND INNOVATION THROUGH ACQUISITION: A CHOICE MODELING APPROACH

1.1 ABSTRACT

While innovation and growth can be promoted internally through focus on research and development (R&D), many firms find acquisition from external sources to be a speedy and attractive alternative. Despite the numerous theories of merger and acquisition in the literature, no empirical study has tackled the problem of target selection in an acquisition. This paper is the first to study the target selection criteria in an empirical setting. It quantifies the elusive concept of synergy by developing novel measures of similarity and complementarity between the acquirer and the target that are more comprehensive than the existing measures in the literature. Using an innovative application of the discrete choice model, the author find that firms use acquisition to promote growth and innovation in areas of strategic interest. Specifically, acquirers choose targets whose product markets match their own R&D projects, and targets whose R&D projects match their own product markets. These findings provide support for the knowledge based view of the firm and lay the foundation for future research in this area.

1.2 INTRODUCTION

"The fundamental impulse that sets and keeps capitalist engine in motion comes from the new consumers' goods, the new methods of production, the new markets, the new forms of industrial organization, ..., that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one." (Schumpeter 1942, p83).

Because of their essential roles in a firm's success, innovation and growth have long been research priorities in the marketing discipline (2008 and 2010 MSI research priorities). While internal R&D can help promote innovation and growth, the process of building a healthy market share and R&D pipeline takes considerable amount of time. A fast and attractive alternative for firms facing intense competition in the marketplace and strong pressure from the stock market is to acquire another firm with existing products and R&D projects. Due to these and other reasons¹, the number of acquisitions (used interchangeably with mergers, M&A) involving US firms is quite high; it peaked in 2006 at 12,000 deals with the total value exceeding 1.4 trillion dollars.

Due to such large amount of acquisition activities and their impact across all organizational functions, acquisitions have been studied in many disciplines (such as economics, strategy, finance and marketing). While numerous theories have been proposed on why firms undertake acquisitions, the empirical literature tests these theories using acquisition outcomes rather than test acquisition motives directly. However, the findings on acquisition outcomes have been mixed²³, and many different acquisition motives may lead to the same acquisition outcome. Therefore, it is difficult to establish a clear link between acquisition outcomes and motivations. Moreover, these studies ignore the integration process in an acquisition (Jemison and Sitkin

¹ Chapter 3 offers a comprehensive review of M&A motivations, and alternative strategies to M&A, such as alliance and direct investment to enter new market

² .Case studies show that many acquirers fail to materialize the promised synergies from an acquisition (Porter 1987). The stock price of the acquiring firm usually decreases, the stock price of target firm usually increases, and that of combined firm is shown to be positive in the short-term (Andrade and Stafford 2004) and negative in the long-run (Loughran and Vjih 1997). However there is no universally accepted measurement for long term stock market return, because the baseline return is under much debate. The impact of acquisitions on R&D is shown to be positive (Weston, Mitchell and Mulherin 2004).

³ .Case studies show that many acquirers fail to materialize the promised synergies (Porter 1987). The stock return of combined firm is shown to be positive in the short-term (Andrade and Stafford 2004) and negative in the long-run (Loughran and Vjih 1997). The impact of acquisitions on R&D is shown to be positive (Weston, Mitchell and Mulherin 2004).

1986) which can drive a wedge between the outcome of an acquisition and its motive. For instance, a failed acquisition could have been caused by sincere but unsuccessful integration effort, rather than selfish empire building incentives of the managers at acquisition planning stage (Amihud and Lev 1981).

Table 1-1: Synergy Measures in Merger and Acquisition Literature^a

	Market Similarity	Market Complementarity	R&D Similarity	R&D Complementarity	Market and R&D Interactions
Singh and Montgomery (1987) ^b	yes		yes		
Harrison et al.(1991) ^c			yes	yes	
Ramaswamy (1997) ^c	yes	Yes			
Hitt et al. (1998)	yes		maybe		
Larsson and Finkelstein (1999)	yes	Yes			
Swaminathan et al. (2008) ^d	yes		yes		
Prabhu et al.(2005)			yes		
Sorescu et al. (2007)	yes				
This paper ^e	yes	Yes	yes	yes	yes

- I acknowledge that the papers in this table may have contributions other than synergy measurement. Here I merely intend to illustrate the design of synergy measures in the literature, with no intention to undermine the contributions of these papers.
- Similar measures are shared by Shelton (1988) and Datta, Pinches, and Narayanan (1992).
- In these papers the “similarity” measure is a distance measure, and the complementarity is considered to be the opposite of similarity. Therefore, one measure is counted for two aspects.
- In this paper the synergy measurement is "Strategic emphasis alignment", which is absolute difference between the acquirer and target strategic emphasis [(advertising expenditures - R&D expenditures)/total assets of the firm].
- The current paper uses different measures for similarity and complementarity. My measures for complementarity capture the new products or knowledge that the potential **target** brings to the **acquirer**, not the other way round. In comparison, my similarity measure is **symmetric** between acquirer and target. Therefore, my similarity and complementarity measures are not polar opposite of each other.

Against this background, this chapter directly tests the theoretical reasons for acquisitions without relying on acquisition outcomes and without being tainted by the integration process. The focus is on the empirical target selection criteria, especially the strategic criteria used by acquirers to choose targets.

Why do two firms want to become one? Synergy has often been cited as one of the prime reasons underlying acquisition decisions⁴ (Walter and Barney, 1990).

Synergy is said to exist when the combined return on a merged company's resources is greater than the sum of its parts. It can arise from many sources, such as economies of scale in operations, increased market power, assimilation of technical or tacit knowledge⁵, favorable financial market treatment of larger firms, diversification of risks, etc (Salter and Weinhold 1979).

Although frequently used in the theoretical literature, synergy remains an elusive concept that has defied accurate measurement. In the empirical literature (as shown in Table 1-1), synergy is often measured by relatedness or similarity (rather than complementarity) in the product markets (rather than R&D projects). The few studies that measure R&D synergy rely on the number and citation of patents (Prabhu, Chandy and Ellis 2005) or R&D spending (Swaminathan, Murshed and Hulland, 2008). However, R&D spending measures the input not the output of innovation whereas patents are an approximate measure for innovation since patent applications represent very early stage of R&D. I quantify the concept of synergy in a holistic manner by developing novel measures of *similarity* and *complementarity* between the acquirer and the potential target in *product markets* and in *R&D projects*, with the latter weighed by their probability of conversion to final products. Besides developing the most comprehensive measures of market and knowledge synergies so far, I also

⁴ In this and the next chapter, I adopt the efficient market assumption (Samuelson 1965; Fama 1965). Under this assumption, it is not possible for acquirer firm to buy target firm on the stock market at a price lower than the target's true value.

⁵ Tacit knowledge is unwritten, unspoken, and hidden vast storehouse of knowledge held by practically every normal human being, based on his or her emotions, experiences, insights, intuition, observations and internalized information. It is integral to the entirety of a person's consciousness, is acquired largely through association with other people, and requires joint or shared activities to be imparted from one to another. Tacit knowledge has also been extended to knowledge held by individuals in an organization. Concept of tacit knowledge was introduced by the Hungarian philosopher-chemist Michael Polanyi (1891-1976) in his 1966 book 'The Tacit Dimension.'

capture the interaction between these two which has not been measured in the literature.

M&A synergies have been categorized into operational synergies, collusive synergies, managerial synergies and financial synergies according to their measurability and the ability to generate benefits (Weston et al 2001, Larsson and Finkelstein 1999). Operational synergies result from economies of scale, for example in production, R&D, staff functions and marketing. This chapter focuses on operational synergies, which are concrete and measurable, and more relevant to marketing field. Collusive synergies result from increased market power and bargaining power. It is captured as part of market synergy in this chapter. Managerial synergies correspond to the efficiencies from the market for corporate control. The underlying assumption is that inefficiently managed firms will be acquired by efficiently managed ones. However, in the pharmaceutical industry (which is the context of this chapter), Higgins and Rodriguez (2006) found that firms experiencing declines in internal productivity (and hence less likely to have superior management) are more likely to engage in an outsourcing-type acquisition in an effort to replenish their research pipelines. Therefore managerial synergies do not appear to be very relevant in the context of this paper. Financial synergies refer to the payoff generated through either higher cash flows or a lower cost of capital (discount rate). A combination of a firm with excess cash, or cash slack, (and limited project opportunities) and a firm with high-return projects (and limited cash) can yield a payoff in terms of higher value for the combined firm. This is likely to contribute to the union of cash rich large firms and small firms with promising projects. However, such synergies cannot exist if the capital markets are efficient since a firm with high return projects can always raise money from the market without relying on internal capital transfers from a cash rich parent. Such synergies are more relevant in

developing countries where capital markets are not well developed (this is also the reason why so many conglomerates exist in developing countries).

Through my measures of operational synergy, I test several hypotheses on acquisition motives suggested by the strategy theory and the knowledge based view of firms (I will review these two in the theory section). I use product market synergy measures to test market power, as well as economies of scale and scope from various firm functions that are related to markets, ranging from production, distribution to marketing. Due to the data limitation, I am not able to further differentiate the sources of these synergies. But I do differentiate them by the different patient markets they serve. I use R&D synergy measures to test knowledge specialization and knowledge spillover effects. Finally, I use synergy measures to capture the interaction between product markets and R&D projects to test the strategic direction of acquirer in terms of balancing short term revenue growth and long term innovation potential.

The empirical setting of this paper is the pharmaceutical industry. Due to the significant amount of acquisition activity and the essential role innovation plays in this industry, it is an ideal testing ground for my topic. This industry has been the focus in several other marketing papers on acquisition and innovation. Swaminathan, Murshed and Hulland (2008) suggest that strategic emphasis alignment—the extent to which the resource configurations of acquirer and target firms are similar to or distinct from one another—is a key construct that facilitates value creation. Homburg and Bucerius (2005) find that market-related performance after the merger or acquisition has a much stronger impact on financial performance than does cost savings. Sorescu, Chandy and Prabhu (2007) claim that the acquirer's product capital affects the success of an acquisition. Prabhu, Chandy and Ellis (2005) find a positive effect of acquisition on innovation. These studies take acquisition deals as given and study their impact on

growth and innovation. In contrast, I study the target selection decision and its link to acquirer's incentive such as achieving growth and innovation synergies.

Using an innovative application of the discrete choice model, I find that firms in the pharmaceutical industry use acquisition to promote growth and innovation in areas of strategic interest. Instead of seeking targets whose R&D portfolios match their own, acquirers choose targets whose products match their R&D projects, thus leapfrogging from research knowledge to immediate market expansion in strategic areas where the acquirer desires to establish its presence and exploit the acquired knowledge to improve its R&D projects. Moreover, instead of acquiring targets with similar product portfolios, acquirers focus on targets whose R&D projects match their products an innovation pipeline in strategic areas with aging products that can be transformed using its experience and resources into marketable products in the future.

These findings provide support for knowledge-based theories of the firm which argue that acquisitions are driven by the desire to acquire tacit knowledge and potential for innovation that are otherwise locked within the boundaries of firms. An ideal target should fit with acquirer's existing knowledge so that the acquired knowledge can be fully utilized, and it should bring in new knowledge to expand the acquirer's reach in future directions, thus promoting growth and innovation in areas of strategic interest.

This paper makes several contributions to the literature. First, this paper pioneers the empirical study of target selection in acquisitions. The extant empirical literature has either studied the outcome of acquisitions (see Trautwein 1990 for a review) or the conditions under which firms tend to initiate mergers (Higgins and Rodriguez 2006, Danzon, Epstein and Nicholson 2007). The choice of target in an acquisition and its link with the acquirer's incentives has been ignored by the empirical literature. To fill this gap, several simulation studies and survey-based

researches have explored target choice (Silhan and Thomas 1986, Kroll and Caples 1987, Schniederjans and Fowler 1989, Rao, Mahanjan and Varaiya 1991), but these approaches lack supports from real data. The empirical target choice studied in this paper serves as a missing link between the theoretical reasons for acquisition and the management decisions in reality.

Second, this paper explicitly models the elusive concept of synergy, thus allowing more accurate and refined testing of the theories on mergers and acquisitions. Using my novel measures of synergy which are more comprehensive than the existing measures, I am able to obtain a better picture of the potential fit between acquirer and target in terms of their products and R&D. These synergy measures help reveal how firms in a knowledge intensive industry use acquisition to achieve immediate growth and long-term innovation potential, complementing the findings of marketing literature on the positive effect of acquisition on growth and innovation.

Third, this paper provides a novel application of the discrete choice model beyond its conventional scope in marketing. The primary application of this model in marketing has been to study brand choice by individuals or households in a Business to Consumer setting. This paper provides a new application of the choice model in Business to Business decision settings. By incorporating the potential synergies from a deal in the decision maker's utility, my model can be adapted to other business settings where mutual gains and strategic fit are important.

1.3 THEORY AND HYPOTHESES

1.3.1 Theory

While many theories have been proposed across academic disciplines⁶ to explain acquisitions, I will focus on the strategy theory and the knowledge based view

6. I did an extended review of M&A theories including strategy theories, process theories, financial theories, governance theories and competence- based theories (including resource-based and

of firm. For a comprehensive review of various acquisition theories, refer to Parvinen (2003).

In the strategy theory, three sources of synergy have been identified related to mergers and acquisitions. These are technical economies, pecuniary economies, and diversification economies (Lubatkin, 1983). Technical economies are scale economies that occur when the physical process inside a firm is altered so that the same amounts of inputs, or factors of production, produce a higher quantity of outputs. The two main types of technical economies are marketing and production economies (Shepherd 1979). These economies can occur in several situations: (i) when the products of two or more businesses use common distribution channels; (ii) where there is an opportunity for tie-in sales that can increase the productivity of the sales force; (iii) where opportunities for common advertising and sales promotion exist; (iv) where common production facilities can be utilized and the overhead spread over larger volume; and (v) when there is R&D carryover from one product to another, and so on (Salter and Weinhold 1979).

Pecuniary economies are achieved by the firm's ability to dictate prices by exerting market power achieved primarily through larger size. The two types of pecuniary economies are monopoly and monopsony economies. The former comes from the ability of a firm to force buyers to accept higher prices. The later comes from the firm's ability to force suppliers to accept lower prices (Porter 1980).

Diversification economies are achieved by improving a firm's performance relative to its risk attributes or by lowering its risk attributes relative to its performance (Lubatkin 1983). Diversifying acquisitions have been shown to bring less gain for acquirers than non-diversifying ones (Singh and Montgomery 1987). Such

knowledge-based views of the firm). Web appendix B discusses these theories and their relevance to this paper in details.

acquisitions are more prone to agency problems. In order to avoid the confounding effect of agency issues, I study deals wherein both acquirer and target are in the same industry, thus ruling out diversification economies as the source of synergy in this study.

The knowledge based view of firm provides a theoretical justification for acquisition based on knowledge and learning. According to this school of thought, firms exist because they produce and utilize knowledge, particularly tacit knowledge, more efficiently than markets (Kogut and Zander 1992); firms' internal organization is a shared context to integrate and utilize essentially local knowledge in order to build and leverage core competencies (Foss and Foss 2000); M&A is the amalgamation of two sets of knowledge resources in order to attain a resource combination, which would not have been attainable otherwise. Such a situation occurs most often in the presence of possibilities for promoting learning and innovation (Parvinen 2003).

The knowledge-based theory has been used by many researchers as the foundation for R&D motivated acquisition (Prabhu, Chandy, Ellis 2005). A distinct stream of literature has concentrated on the transfer and acquisition of unique technologies through M&A (Hagedoorn and Sadowski 1999). Organizational learning through M&A (e.g. Haleblian and Finkelstein 1999) and M&A for technological and organizational innovation (e.g. Kabiraj and Mukherjee 2000) are related explanations for a merger. The main idea behind these explanations is that acquisition provides access to target's tacit knowledge which is difficult to imitate but is a critical source of innovation.

There are areas of overlap between the strategy theory and the knowledge based theory. For example, the acquisition of products can be explained by the strategy school as production economies of scale and by the knowledge-based theory as the desire to learn the production knowledge embedded in the target product. Similarly,

the acquisition of R&D projects can be motivated by the strategy school as scale economy in R&D, and by the knowledge-based theory as the only way to obtain target's proprietary technology and tacit knowledge. I now develop more refined hypotheses on acquisition incentives using these two theories.

1.3.2. Hypotheses

In the following subsections I specify six hypotheses derived from M&A related theories. These hypotheses are not necessarily in agreement with each other, and they may not be all supported at the same time. It is possible that one theory works for some M&A deals and another theory works for other deals. The empirical model test the overall effect of the M&A motivations, and the dominant incentives will be significant in the estimation result.

1.3.2.1 Market Intensification

An acquirer may want to choose a target that has products similar to itself. On the supply side, efficiency can increase when resources are shared for the production and distribution of larger quantity of similar products. Such scale economies can occur in functional areas, such as manufacturing, R&D, and selling and distribution (Salter and Weinhold, 1979; Rumelt, 1974), as well in administration and financial management. The scale economy can also be explained by transaction cost economics since the larger scale lowers the transaction costs of using a factor of production (Richter 1999).

On the demand side, acquisition of similar products may increase the market power of the combined company. A market participant is said to have market power when it has the ability to influence price, quantity, and the nature of the product in the marketplace (Shepherd, 1970:3). Market power, in turn, may lead to excess returns. A firm's market power may be increased through horizontal acquisitions or through

market extension acquisitions since its effective size is increased relative to its competitors. These arguments lead to my first hypothesis:

H1: In an acquisition, the acquirer seeks a target whose product portfolio reinforces its own.

Empirical research by Ajuha and Katila (2001) suggests that too much business overlap causes redundancy and reduces learning from each other, whereas too little overlap causes difficulty in integration. Therefore the relationship between similarity in business and synergy may resemble a bell curve: synergy increases first as companies are far apart from each other, but starts decreasing after a certain point. I will test for such bell curve shape as a robustness check for H1.

1.3.2.2 Market Expansion

Many firms regard acquisition as a quick way to expand into new markets, obtain new distribution channels, and acquire new production techniques. Referred to as economy of scope, synergy arising from such situations can come from utilization of the same set of resources, such as production facilities, distribution channels, and management personnel (Salter and Weinhold, 1979; Rumelt, 1974). The difference between economy of scale and economy of scope lies in the degree of resource sharing. Scale economies arise when capacity utilization is increased through additional production of a single (type of) product, and scope economies arise when capacity utilization is increased through the shared production of two or more (different types of) products (Singh and Montgomery 1987). For example, two antibiotic drugs can share common production facilities and sales force, whereas a cancer drug and a common cold drug may only benefit from managerial sharing and financial economies. These arguments lead to my second hypothesis:

H2: In an acquisition, the acquirer seeks a target with product markets that the acquirer lacks

1.3.2.3 R&D Intensification

An acquirer interested in pipeline replenishment may want to choose targets that have R&D projects similar to itself. As in the case of product markets, economies of scale in R&D can also generate potential efficiency gains through sharing of R&D facilities, and collaboration of research scientists. Moreover, acquisition of similar R&D can be motivated using knowledge specialization. Knowledge is created by individual human beings, and to be efficient in knowledge creation and storage, individuals need to specialize (Simon 1991). Developing depth of knowledge in key fields enables firms to gain competency and produce new knowledge in those fields, and thus innovate (Hamel and Prahalad 1994). Expertise in a field also enables an acquiring firm to judge whether a target firm's technology is genuinely valuable, thus helping pick better targets (Cohen and Levinthal 1990). Moreover, the similarity of knowledge between the acquirer and the target is crucial to the acquirer's ability to absorb the target's knowledge and use it for innovation (Cohen and Levinthal 1990). Therefore, I propose the following hypothesis:

H3: In an acquisition, the acquirer seeks a target with pipeline projects that strengthen the acquirer's existing R&D portfolio.

However, in the case of highly similar R&D acquisitions, there will be less new knowledge to absorb. Too much relatedness may result in overlapping and redundant research (Rindfleisch and Moorman 2001) and fewer opportunities to combine different types of knowledge in creative ways. Cockburn and Henderson (2001) find no returns to scale for pharmaceutical firms in their research effort. Prabhu, Chandy

and Ellis (2005) suggest a bell shape relationship between knowledge similarity and innovation. I will address this issue as a robustness check.

1.3.2.4 R&D Expansion

Although specialization can improve efficiency, with changes in market preferences and technological opportunities, knowledge that was once a source of competitive advantage may become irrelevant (Volberda 1996). To avoid being locked out of emerging technical domains, firms need a broad base of knowledge (Leonard-Barton 1995). Although some researchers find that greater breadth can cause a firm to spread resources too thinly (Wernerfelt and Montgomery 1988), most of the research suggests that breadth in knowledge is helpful for innovation (Cohen and Levinthal 1990; Henderson and Cockburn 1994). The broader a firm's existing knowledge, the greater is its ability to combine knowledge in related fields in a more complex and creative manner (Kogut and Zander 1992), and the knowledge spillover may result in unexpected discoveries (Prabhu, Chandy and Ellis 2005). Cockburn and Henderson (2001) found that diversity of research portfolio help pharmaceutical companies deliver superior performance in drug development. Therefore, the acquirer may want to achieve breadth of knowledge through acquisitions, which is the base for the following hypothesis:

H4: In an acquisition, the acquirer seeks a target with pipeline projects extending beyond the acquirer's existing R&D project portfolio.

1.3.2.5 Market to R&D Intensification

The knowledge based theory provides us a new lens to look at all activities in a firm as knowledge. As Kogut and Zander (1992) claim, firms exist because they produce and utilize knowledge, particularly tacit knowledge more efficiently than markets. From this perspective, the firms which successfully convert R&D projects

into marketable products and support those products with marketing, sales, and distribution channels possess important knowledge from these experiences. Such experiences can be very valuable for other firms that have incomplete R&D project in similar areas. Successful implementation of these processes also requires upfront investment in production, marketing, and distribution channels, which a small firm with a good R&D project may not be capable of. Therefore synergies can be created through the fusion of a firm with existing products and sufficient revenue, and a firm with R&D projects in similar areas that need prelaunch support. Such acquisitions can also help the acquirer build its long-term innovation potential in strategic areas with aging products that can be transformed into marketable products in the future. Therefore, I propose the following hypothesis.

H5: In an acquisition, the acquirer seeks a target with product pipeline in markets similar to its existing products.

1.3.2.6 R&D to Market Intensification

Visionary CEOs set their eyes on the future when they choose which R&D projects to develop. Therefore a company's pipeline should reflect its future direction. However, the progress of R&D projects is slow and not always on schedule. If the company is eager to enter a new market, but its internal R&D is not ready, acquiring existing products is a natural alternative. Taking over a potential rival firm can alleviate the need for future price competition and increase future profit. The expertise acquirer has gained from its existing R&D projects can help judge the potential of the target firm's products (Cohen and Levinthal 1990). From the knowledge-based theory, synergies can arise in such a case if the acquirer can exploit the knowledge gained from the acquired products to improve its delayed R&D project or create new knowledge. In short, an acquirer may seek immediate revenue growth by choosing a

target whose products match its R&D portfolio because of its desire to establish its presence in those markets and exploit the acquired knowledge to improve its R&D projects. This leads to my final hypothesis:

H6: In an acquisition, the acquirer seeks a target that has existing products in areas similar to the acquirer's R&D projects.

1.4 MODEL AND ESTIMATION METHOD

1.4.1 Model Specification

I use the discrete choice model to study the firm's choice of acquisition target. This paper is one of the pioneers to apply the choice model to corporate decision making context and the first to apply it to study acquisition choice. Levine (2007) has applied the choice model to corporate decision making in the drug licensing market.

I introduce the choice model with random utility framework (McFadden 1973). Acquirer, labeled j , faces a choice among K alternative targets. The acquirer j chooses an alternative that provides the highest utility $U_{jk} > U_{jd}, \forall d \neq k, d, k \in (1, \dots, K)$. The utility expression can be decomposed as $U_{jk} = V_{jk} + \varepsilon_{jk}$, where ε_{jk} captures the factors that are observed by the acquirer but are not observed by the researchers (Train 2003, p24). To obtain a close form solution, ε_{jk} is assumed to follow i.i.d. extreme value distribution with mean 0 and variance $\pi^2/6$. Under this assumption, the probability that acquirer j chooses alternative k is: $P_{jk} = \text{Prob}(U_{jk} > U_{jd} \forall d \neq k) = e^{V_k} / (\sum_d e^{V_{jd}})$.

Given that I utilize data over multiple years, I add the subscript for time. The model is estimated using maximum likelihood estimation with the log-likelihood expression:

$LL = \sum_{j=1}^J \sum_t \sum_k y_{jkt} \ln P_{jkt}$, where y_{jkt} is an indicator variable representing the acquirer's choice. I formulate the overall utility of acquirer firm j from choosing alternative k at time t as:

$$U_{jkt} = \underbrace{\sum_{o=1}^O \alpha_o f_{k,o,t}}_1 + \underbrace{\sum_{m=1}^M \beta_m D_{k,m,t}}_2 + \underbrace{\sum_{n=1}^N \kappa_n \phi_{j,k,n,t}}_3 + \varepsilon_{j,k,t} \quad (1)$$

In the utility specification, I include three sets of variables. O is the number of financial variables, M is the number of control variables, and N is the number of synergy variables.

- ♦ $F_{k,t} = (f_{k,1,t}, f_{k,2,t}, \dots, f_{k,O,t})$ denotes the vector of financial attributes of the alternative k at time t .
- ♦ $D_{k,m,t}$ denotes control variables, such as the target to acquirer sales ratio. I will discuss these variables in detail in following paragraphs.
- ♦ $\phi_{j,k,n,t}$ denotes the non-financial synergy between the acquirer firm j and alternative firm k at time t . I measure this synergy using intensification and expansion factors as discussed in the following paragraphs.
- ♦ $\varepsilon_{j,k,t}$ follows i.i.d. extreme value distribution

I do not include acquirer characteristics as stand-alone variables because in conditional logit model. Any j specific terms that are not interacted with target k related-variables will drop out from the estimation and cannot be identified. The variables $F_{k,t}$, $D_{k,m,t}$ and $\phi_{j,k,n,t}$ used in the estimation are provided in Table 1-2. These three components of the utility function are described below.

Financial variables: The first component of the utility function comprises three variables selected out of 22 financial and accounting variables that measure the overall wellbeing of the target. I use factor analysis to assist in the variable selection process, the details of which are discussed in the data section. The three selected variables are Total Assets, Book Leverage, and Return on Assets. Total Assets measures the overall scale of the firm's business and is correlated with sales and R&D expenditure. Book Leverage measures the proportion of the firm's book assets that are financed by book debt rather than book equity. If this ratio is too high, the company may face the risk of financial distress because of high interest expense and if this ratio is too low, the

company is not fully utilizing the tax shield of debt. Return on Assets is a profitability measure calculated as the income generated by the firm as a proportion of its assets.

Table 1-2: Explanation of Variables

Parameters	Explanation
<i>First component: financial variables</i>	
Total Assets	potential target firms' annual sales (billion \$)
Debt to Asset Ratio (DTA)	potential target firm's total liabilities over total assets
Return on Assets (ROA)	potential target firm's net income over total shareholder equity
<i>Second component: control variables</i>	
Large_dummy	dummy variable representing firms with market value greater than 10 billion dollars
Alliance_dummy	dummy variable indicating that the alternative had alliance relationship with the acquirer firm prior to the acquisition
Biotechnology	Dummy variable for biotechnology focus, proxy for scientific culture
Sales Ratio	Ratio of target sales to Acquirer sales, proxy for organizational culture
SIC Matching	Dummy indicating whether the acquirer and target are in the same SIC category, proxy for market culture
<i>Third component: synergy variables</i>	
<i>Product and Pipeline synergies</i>	
Market Intensification	similarity between acquirer and alternative based on approved drugs (for H1)
Market Expansion	complementarity between acquirer and alternative based on approved drugs (for H2)
R&D Intensification	similarity between acquirer and alternative based on pipeline (for H3)
R&D Expansion	complementarity between acquirer and alternative based on pipeline (for H4)
Market to R&D Intensification	similarity between acquirer's products and target's pipeline (for H5)
R&D to Market Intensification	similarity between acquirer's pipeline and target's products (for H6)
<i>Financial synergies</i>	
$(Assets_a - Assets_t)^2$	dispersion of acquirer's and potential target's total assets
$(DTA_a - DTA_t)^2$	dispersion of acquirer's and potential target's debt-to-asset ratio
$(ROA_a - ROA_t)^2$	dispersion of acquirer's and potential target's return of assets

Control variables: I use several control variables based on the findings of previous research. An “alliance” dummy is included based on the findings of Higgins and Rodriguez (2006) that firms are more likely to acquire past or current alliance partners because they have more information about those firms through the alliance

relationship. A “large firm” dummy is motivated by the finding of Danzon, Epstein and Nicholson (2007) that large acquisitions behave very differently from small ones. This is intuitive since acquiring a large firm is expensive and requires considerable executive resources to plan the challenging integration processes after merger. I include “culture” variables used by Prabhu, Chandy and Ellis (2005), because cultural differences can affect the integration process. The culture here refers to organizational culture, market culture, and scientific culture of the acquirer and the potential target firms. I measure organizational culture with the ratio of acquirer’s size and potential target’s size (measured by sales); market culture with a dummy variable indicating the matching of Standard Industrial Classification (SIC) codes of acquirer and potential target; scientific culture with a dummy variable indicating whether the potential target is a biotechnology company.

Synergy variables: In this section, I provide a general framework for calculating potential synergies which can be readily adapted to other industries. The data section explains how the framework is used in this paper.

Assume that the set of all drugs $D = \{D_1, D_2, \dots, D_{I+J}\}$ comprising approved drugs $A = \{A_1, \dots, A_I\}$ and pipeline drugs $P = \{P_1, \dots, P_J\}$ with $D = A \cup P$ can be classified into therapy classes $C = \{C_1, \dots, C_K\}$ using some criteria such as the type of disease each drug treats. Let this classification be given by the mapping $f : D \rightarrow C$. Also, assume that the mapping $g : D \rightarrow R^+$ assigns a positive real valued *score* to each drug in D , based on the market potential of that drug. The market potential of a drug could be measured by the sales revenue for an approved drug and the expected sales revenue for a pipeline drug. If sales figures are not available, market potential could be proxied by the clinical probability of FDA approval for a pipeline drug and the patent status for an approved drug.

Assume that C can be partitioned as a tree with non-overlapping nests based on the proximity of therapy classes in C . Let this partition be represented by $C = C^1 \supset C^2 \supset \dots \supset C^N$ subject to the conditions $C^n = \bigcup_{j \in C^n \setminus C^{n+1}} C_j^n$ and $C_j^n \cap C_k^n = \phi \quad \forall j, k \in C^n \setminus C^{n+1}$ where C_j^n include the node C_j^{n+1} itself and all the branch structure below this node. Here n represents the level of hierarchies in the tree (ranging from the highest level 1 to lowest level N), C^n is the set of all therapy classes that are at level n or below, $C^n \setminus C^{n+1}$ is the set of all therapy classes at level n (but not below), and C_j^n is the sub-tree originating from therapy class j at level n . A proximity tree is illustrated in Figure 1-1. The classification of therapy classes into various nests of a proximity tree could be done using a variable $d(C_i, C_j)$ which measures the relative distance between therapy classes C_i and C_j .

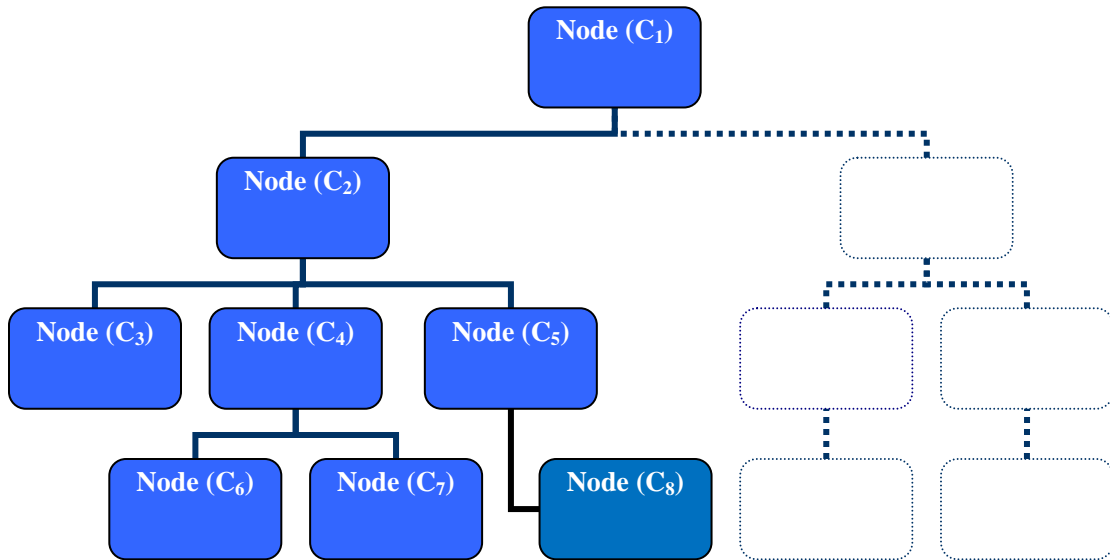


Figure 1-1: An Illustration of Proximity Tree

Assume that a firm x has a portfolio of drugs $D^x = A^x \cup P^x$. The *market score* of firm x for therapy class C_i given by $s_a(C_i, x) = \sum_{A_i \in I^{-1}(C_i) \cap A^x} g(A_i)$ captures the market potential of approved drugs of firm x in therapy class C_i . Likewise, the *R&D score*

$s_p(C_j, x) = \sum_{P_j \in I^{-1}(C_j) \cap P^x} g(P_j)$ captures the market potential of all pipeline drugs of firm x in

therapy class C_j .

The **market intensification factor** $\phi_{a,a}^I(x,y)$ for acquirer x and potential target firm y measures the similarity of the two firms' approved drugs using the following expression:

$$\phi_{a,a}^I(x,y) = \sum_{C_i \in \{z: z=I(A_i) \forall A_i \in A^x\}} \sum_{C_j \in \{z: z=I(A_j) \forall A_j \in A^y\}} h(d(C_i, C_j), s_a(C_i, x), s_a(C_j, y)) \quad (1-1)$$

where $h: R^3 \rightarrow R$ is subject to $\frac{\partial h_{a,a}(d,r,s)}{\partial d} \leq 0$, $\frac{\partial h_{a,a}(d,r,s)}{\partial r} \geq 0$ and $\frac{\partial h_{a,a}(d,r,s)}{\partial s} \geq 0$.

Here, $h(d(C_i, C_j), s_a(C_i, x), s_a(C_j, y))$ captures the similarity of the acquirer's approved drugs in therapy class C_i and the target's approved drugs in therapy class C_j . This similarity factor decreases with the distance between C_i and C_j and increases with the market potential of acquirer's approved drugs in C_i and the target's approved drugs in C_j . The market intensification factor is the sum of these similarity factors across all the acquirer and target therapy classes.

The **R&D intensification factor** $\phi_{p,p}^I(x,y)$ is defined similar to the market intensification factor except that it uses R&D scores to measure the similarity of the two firms' pipeline drugs

$$\phi_{p,p}^I(x,y) = \sum_{C_i \in \{z: z=I(P_i) \forall P_i \in P^x\}} \sum_{C_j \in \{z: z=I(P_j) \forall P_j \in P^y\}} h(d(C_i, C_j), s_p(C_i, x), s_p(C_j, y)) \quad (1-2)$$

The **market to R&D intensification factor** $\phi_{a,p}^I(x,y)$ is defined similar to the above factors to measure the similarity of the acquirer's approved drugs with the target's pipeline drugs.

$$\phi_{a,p}^I(x,y) = \sum_{C_i \in \{z: z=I(A_i) \forall A_i \in A^x\}} \sum_{C_j \in \{z: z=I(P_j) \forall P_j \in P^y\}} h(d(C_i, C_j), s_a(C_i, x), s_p(C_j, y)) \quad (1-3)$$

The **R&D to market intensification factor** $I_{r,m}(x,y)$ is defined similar to the above factors to measure the similarity of the acquirer's pipeline drugs with the target's approved drugs.

$$\phi_{p,a}^I(x,y) = \sum_{C_i \in \{z: z=l(P_i) \forall P_i \in P^x\}} \sum_{C_j \in \{z: z=l(A_i) \forall A_i \in A^y\}} h(d(C_i, C_j), s_p(C_i, x), s_a(C_j, y)) \quad (1-4)$$

The **market expansion factor** $\phi_{a,a}^E(x,y)$ measures the complementarity of the target's approved drugs to the acquirer's approved drugs. It is given by

$$\phi_{a,a}^E(x,y) = \sum_{C_j \in \{z: z=l(A_i) \forall A_i \in A^y\}} r(d(C_A^x, C_j), s_a(C_j, y)) \quad (1-5)$$

where $d(C_A^x, C_j) = \min\{d(C_i, C_j) : C_i \in \{z : z \in f(A_i) \forall A_i \in A^x\}\}$, and the mapping

$r : R^2 \rightarrow R$ is subject to $\frac{\partial r_{a,a}(d,s)}{\partial d} \geq 0$ and $\frac{\partial r_{a,a}(d,s)}{\partial s} \geq 0$. Here

$r(d(C^x, C_j), s_m(C_j, y))$ captures the complementarity of the target's approved drugs in therapy class C_j to all the approved drugs of acquirer in any therapy class. This complementarity factor increases with the *minimum* distance between C_j and the set C^x of all therapy classes to which acquirer's approved drugs belong and increases with the market potential of target's approved drugs in C_j . The market expansion factor is the sum of such complementarity factors across all target therapy classes. This specification aims to capture the new products brought by the target to the acquirer and not the other way round.

The **R&D expansion factor** $\phi_{p,p}^E(x,y)$ is defined similar to the market expansion factor to measure the complementarity of the target's pipeline drugs to the acquirer's pipeline drugs.

$$\phi_{p,p}^E(x,y) = \sum_{C_j \in \{z: z=l(P_i) \forall P_i \in P^y\}} r(d(C_P^x, C_j), s_p(C_j, y)) \quad (1-6)$$

Table 1-2 summarizes the above six factors and lists the hypothesis each factor is meant to test. An example of the synergy factors calculated is included in 1.5.3.

1.4.2 Model Robustness and Out of Sample Prediction

I use several methods to test the robustness of my result. First, I perform a bootstrapping procedure on the model to see whether my findings are biased by the small sample. Second, I use the parameter estimates to make out of sample predictions to see whether the inclusion of synergy variables improves the model's predictive

power. Third, I test the nonlinearity of product and R&D intensification factors as suggested in the hypotheses section. Finally, I include financial synergies between the merging firms based on the balance model in Rao, Mahajan and Varaiya (1991). These financial synergies are measured using the dispersion (variance) of the financial variables of the acquirer and the potential target.

1.4.3 Methodological Challenges

There are two methodological challenges to the current setup. One is choice set determination; the other is manager's incentives.

1.4.3.1 Choice set determination

One challenge in applying the choice model to the acquisition setting is that the researcher does not observe the choice alternatives. The acquiring firm reveals the chosen target but says little about the other firms that were considered for the same deal. In theory, the choice set includes all the pharmaceutical firms existing at the deal announcement date. However, my comprehensive synergy measures are too cumbersome to calculate for all the firms in each year. Therefore I adopt the random sampling of alternatives suggested by McFadden (1977) and Train (2003). This method estimates the conditional logit model on a subset of alternatives comprising the true target and a random sample of alternatives selected from the entire alternative pool⁷. A proof from Train (2003, p68-69) in the next paragraph shows that the logit estimation with such sampling of alternatives produces consistent estimates of the true parameters. I also include the estimation results with this method on simulated data with various sample sizes to support the use of this method for my sample size. The

⁷ According to Train (2003), "With a logit model, consistent estimation can be performed on a subset of alternatives. For example, a choice situation involving 100 alternatives can be estimated on a subset of 10 alternatives for each sampled decision maker, with the person's chosen alternative included as well as 9 alternatives randomly selected from the remaining 99. The estimation proceeds on the subset of alternatives as if it were the full set."

random sampling of alternatives has been used in many situations with the more general nested logit models. Examples include households' choices of automobiles (Manning and Winston, 1985), households' choices of dwelling location and unit (Weisbrod, Lerman, and Ben-Akiva, 1980), travelers' choices of destination (Daly, 1982), and the demand for residential telephone service (Train, McFadden and Ben-Akiva, 1987).

Logit Estimation with Randomly Sampled Alternatives Proof of Consistency

This section reproduces a proof from Train (2003) regarding the consistency of logit estimation with randomly sampled alternatives.

Suppose that the researcher has used some specific method for randomly selecting alternatives into the subset that is used in estimation for each sampled decision maker. Denote the full set of alternatives as F and a subset of alternatives as K . Let $q(K | i)$ be the probability under the researcher's selection method that subset K is selected given that the decision maker chose alternative i . Assuming that the subset necessarily includes the chosen alternative, I have $q(K | i) = 0$ for any K that does not include i . The probability that person n chooses alternative i from the full set is P_{ni} . My goal is to derive a formula for the probability that the person chooses alternative i conditional on the researcher selecting subset K for him. This conditional probability is denoted $P_n(i | K)$. This conditional probability is derived as follows. The joint probability that the researcher selects subset K and the decision maker chooses alternative i is $\text{Prob}(K, i) = q(K | i)P_{ni}$. The joint probability can also be expressed with the opposite conditioning as $\text{Prob}(K, i) = P_n(i | K)Q(K)$ where $Q(K) = \sum_{j \in F} P_{nj}q(K | j)$ is the probability of the researcher selecting subset K marginal over all the alternatives that the person could choose. Equating these two expressions and solving for $P_n(i | K)$, I have

$$P_n(i | K) = \frac{P_{ni} q(K | i)}{\sum_{j \in F} P_{nj} q(K | j)} = \frac{e^{V_{ni}} q(K | i)}{\sum_{j \in F} e^{V_{nj}} q(K | j)} = \frac{e^{V_{ni}} q(K | i)}{\sum_{k \in K} e^{V_{nk}} q(K | j)}$$

where the second line has canceled out the denominators of P_{ni} and $P_{nj} q(K | j)$, and the third equality uses the fact that $q(K | j) = 0$ for any j not in K .

Suppose that the researcher has designed the selection procedure so that $q(K | j)$ is the same for all $j \in K$. This property occurs if, for example, the researcher assigns an equal probability of selection to all non-chosen alternatives, so that the probability of selecting j into the subset when i is chosen by the decision maker is the same as for selecting i into the subset when j is chosen. McFadden (1977) calls this the “uniform conditioning property,” since the subset of alternatives has a uniform (equal) probability of being selected conditional on any of its members being chosen by the decision maker. When this property is satisfied, $q(K | j)$ cancels out of the preceding expression, and the probability becomes: $P_n(i | K) = e^{V_{ni}} / (\sum_{j \in K} e^{V_{nj}})$, which is simply the logit formula for a person who faces the alternatives in subset K .

Simulation with different sample sizes

This section contains simulation results with different sample sizes. I conduct a simulation to study the ability of the model to recover parameters with different sample sizes and different number of true alternatives. In this simulation, I assume a utility function of the form $U = b_1 * x_1 + b_2 * x_2 + e$, where x_1 and x_2 are object attributes, and e is an error term following extreme value distribution with shift 0 and scale 1. The true values used for b_1 and b_2 are 1 and 2 respectively, and x_1 and x_2 are simulated using standard normal distribution. I simulate various scenarios: the number of true alternative targets M is 100 or 500, and the number of acquirers N who make the choice is 30 or 100. My sample has 29 deals (and hence 29 acquirers) and I randomly draw 9 alternative targets (besides the true chosen target) from a pool of

500-600 true alternative targets. So the simulation that best corresponds to my case is where the number of acquirers is 30 and the number of true alternative targets is 500.

Table 1-3: Simulation for Logit with Random Sampling Method

No. of Acquirer: N	No. of True Alternative Targets M	True Value	Full Sample					Randomly Selected Sample of 10 alternate targets				
			Parameter Estimate ^a	Std Err ^a	True Value lies within 1 StdErr	True Value lies within 2 StdErr	T-test on two sample estimate ^b	Parameter Estimate ^a	Std Err ^a	True Value lies within 1 StdErr	True Value lies within 2 StdErr	
30	100	1	1.02 ^c	0.26 ^c	69%	95%	0.90	1.15	0.39	87%	100%	
		2	2.05 ^c	0.29 ^c	68%	95%	0.90	1.93	0.39	92%	100%	
	500	1	1.01 ^c	0.21 ^c	68%	96%	0.92	1.11	0.34	86%	100%	
		2	2.02 ^c	0.23 ^c	69%	96%	0.87	2.19	0.52	89%	100%	
100	100	1	1.01	0.14	70%	96%	0.96	1.06	0.33	89%	100%	
		2	2.02	0.16	70%	97%	0.82	2.25	0.38	73%	100%	
	500	1	1.00	0.12	68%	96%	0.84	1.21	0.24	60%	98%	
		2	2.00	0.13	67%	96%	0.86	2.18	0.26	70%	98%	

Notes:

^a The reported values here are means of estimation results from 1000 repetitions.

^b The t-test was conducted on two sets of parameter estimates of 1000 each from full and randomly selected sample. ^c One estimation result is removed, because it has standard error >600.

I first conduct conditional logit estimation on the full sample, and then I apply random sampling as described in the paper, with 9 randomly drawn alternative targets plus the true chosen target, and run conditional logit estimation on the selected sample. I repeat this process 1000 times and report the results for both estimations in Table 1-3. As expected, the estimation with randomly selected sample has greater bias in parameter estimates and larger standard errors than the full sample estimation. However, the selected sample estimations use much less observations than full sample estimation. Taking this into account, the selected sample estimation does a reasonable job in recovering the true value. In Table 1-3 the true value falls within 2 standard errors of the parameter estimate almost all the time, and within 1 standard error of the parameter estimate most of the time. I also conduct t-tests between the parameter estimates in the two samples and fail to reject the null hypothesis that the two

parameter estimates are equal. Therefore, the simulation study supplements the theoretical proof by Train (2003) and supports the use of the random sampling logit method for my sample size.

1.4.3.2 Managers' incentives

As corporate finance and agency theories suggest, managers may undertake sub-optimal acquisitions due to empire building or risk diversification motives. To avoid the assumption of optimality, I not only exclude diversifying acquisitions across industries, but also do not include the outside option of not acquiring in the model. In other words, I take the decision to acquire as given and look only at target choice. Even if the acquisition is not entirely optimal, I assume that the managers try to choose the most suitable target after the decision to acquire has been made.

1.5 DATA

1.5.1 Sample and Data Collection Procedure

Three main pieces of data are used in the empirical analysis: (a) deal related information (b) accounting and financial information for the acquirer and the potential targets; and (c) product and pipeline drugs of the acquirer and the potential targets. The data sources for these three pieces are included in Table 1-4.

I select deals between January 2002 and June 2008 where both the acquirer and the target were US public companies in the pharmaceutical industry (SIC code in 2830 category). The reason for restricting the sample to this period is explained in the subsequent paragraphs. The study is restricted to US companies to keep the choice set manageable (it is hard to get comprehensive information on pharmaceutical companies around the world) and to make the accounting data comparable across firms (since accounting standards differ across countries). I choose public acquirers and targets because public firms have relatively complete accounting data. However, I believe my findings can be generalized to private targets to some extent because a multivariate

variance analysis (MANOVA) suggests that acquisition samples with public and private targets are not statistically different from each other⁸. I also delete the deals for which no product and pipeline information can be found in Inteleos. The final observation sample has 29 deals⁹. Since this is a relatively small sample (although it meets the requirement for central limit theorem and the simulations in 1.4.3.2 support the random sampling logit estimation for this sample size), I conduct bootstrap analysis to verify the robustness of my findings.

Table 1-4: Data Sources

Information Description	Variables	Data source
Deal related information	Deal date; acquirer and target firm name, public status, industry SIC code, deal purpose; etc.	SDC Platinum* M&A
Financial information	Sales, assets, liabilities, market value, etc.	Compustat
Full choice set of potential targets	List of public pharma firms in 2001-2008	Compustat
Product and pipeline information	Each firm's approved and pipeline drugs in all clinical stages	Inteleos **/Capital IQ
Alliance Information	Dummy for alliance history	SDC Platinum Strategic Alliance/Capital IQ

* SDC Platinum is a professional dataset offered by Thomson Financial

** Inteleos™ (online version of NDA Pipeline) is a commercial database provided by Elsevier that tracks the drug development activity from late-stage preclinical through launch and post-marketing studies. It is updated daily and has coverage of more than 8000 drugs from more than 1200 companies.

Comparison between public and private target sample

I have conducted Multivariate Analysis of Variance (MANOVA) to measure differences in financial ratios of public acquirers and public or private target firms.

⁸ I conducted individual and joint MANOVA tests on public and private samples based on four financial ratios, namely sales ratio; total assets ratio; current assets ratio; and liability ratio (calculated as target value/acquirer value). None of the tests reject the null hypothesis that the two samples are not different from each other. Results are available upon request.

⁹ SDC Platinum contains 644 acquisition deals in the Pharma industry between January 2002 and June 2008. Of these, 594 deals dropped out because the acquirer or the target is not a public firm. Additional 20 deals dropped out due to missing product and pipeline information in Inteleos. Finally, one deal is dropped as an outlier because the target is unusually larger the acquirer (their ratio is more than two standard deviations higher than the historical mean).

Firstly four financial ratios tested individually. Then a joint test is conducted on the two samples based on these four financial ratios. The financial ratios are: sales ratio ($\text{target_sales}/\text{acquirer_sales}$); total assets ratio ($\text{target_total_assets}/\text{acquirer_total_sales}$); current assets ratio ($\text{target_current_assets}/\text{acquirer_current_assets}$); and liability ratio ($\text{target_liabilities}/\text{acquirer_liabilities}$).

The results are shown as following:

Table 1-5: Individual Testing of the Financial Ratios between Private and Public Targets

Variable	DF	Contrast Sums of Squares	F-value	Pr>F
sales ratio	1	0.5131	0.71	0.3981
total asset ratio	1	0.4889	0.15	0.7014
current assets ratio	1	1.1668	0.18	0.6718
current liability ratio	1	0.081	0.16	0.6942

The “contrast sums of squares” is a test on the incremental improvement in error sums of squares as the effect is added to the model. The tests null hypothesis of private and public targets financial ratios not different from each other can not be rejected.

Table 1-6: MANOVA Test Criteria and Exact F Statistics for the Hypothesis of No Overall Public vs Private Target Effect

Statistic	Value	F value	Num DF	Den DF	Pr > F
Wilks' Lambda	0.97	0.46	4	52	0.77
Pillai's Trace	0.03	0.46	4	52	0.77
Hotelling-Lawley Trace	0.03	0.46	4	52	0.77
Roy's Greatest Root	0.04	0.46	4	52	0.77

Notes: For the MANOVA Test, H = Contrast SSCP Matrix for Public vs Private Target, E = Error SSCP Matrix

These joint tests show that the null hypothesis that public and private target sample are the same cannot be rejected. Therefore my study based on public acquirer and public target can be generalized to broader settings.

The random sampling of target alternatives discussed in the previous section is done as follows. The full choice set for each deal consists of all US pharmaceutical

firms that were publicly owned in the same year or the year before the deal announcement. The full choice set is around 500 firms for each deal. For each deal, I keep the target and randomly select 9 other firms from the full choice set for that deal. Data are collected for these subsets of alternatives.

The financial and accounting data are obtained for the quarter ending just before the announcement of a deal. I collect data on 23 relevant variables. Because these variables are highly correlated, I do factor analysis with Varimax rotation to reduce the number of variables. The first three factors explain 75% of the total variance. I take the variable with the highest factor loading on each of these three factors. The three variables so obtained, namely total assets, book leverage, and return on assets, are used as independent variables in the estimation.

Since Inteleos contains current rather than historical snapshot of product and pipeline data (my data was collected as of June 2008), following steps and approximations are used to recover the product and pipeline status at the time of each deal. First, I purge the approved and pipeline drugs that were acquired by the acquirer and target alternatives through later acquisitions after the deal date in my study¹⁰. The list of acquisitions by the acquirer and target alternatives after the deal announcement date is obtained from the Capital IQ database. Second, I use the research project status comments in Inteleos to recover the research stage at time of merger. When the status comments are not available, I use the average duration in each clinical phase from DiMasi and Grabowski (2007)¹¹ to recover the product and pipeline status of the

¹⁰ In some cases the target firm is not directly available in Inteleos after the acquisition because Inteleos counts the acquired drugs as acquirer's. However, Inteleos puts a note to this effect in the license overview of the acquirer's drugs. In such cases, I obtain the target pipeline by searching the target firm's name in the license overview section of the acquirer's drugs.

¹¹ The average duration of preclinical, phase I, phase II, phase III, and pending approval stages are 5.03, 1.80, 2.14, 2.54, and 1.52 years respectively.

acquirer and target alternatives on the deal date¹². Since the average duration between preclinical stage and drug approval is around 6 years, I do not use deals prior to 2002 in my sample because the further back I go back from June 2008 when the data was collected, the less accurate it is to recover the clinical stage of a drug on the deal date. Finally, I obtain the history of any alliances between the acquirer and the target alternatives from the licensing review section in Inteleos database and from SDC Platinum strategic alliance database.

1.5.2 Summary Statistics

Table 1-7: Summary Statistics for Targets and Alternative Target Firms

Variable	Target			Alternatives		
	Mean	Std Dev	Median	Mean	Std Dev	Median
Assets (Million \$) ^a	1047.76	4107.63	186.78	449.96	2300.66	41.76
Return on Assets(ROA) ^b	-0.06	0.12	-0.04	-0.28	0.89	-0.12
Book Leverage(BL) ^c	0.45	0.67	0.23	0.71	1.55	0.35
Large	0.03	0.19	0	0.01	0.11	0
Alliance	0.21	0.41	0	0.01	0.09	0
Market Intensification	131.07	571.18	0	49.29	381.23	0
Market Expansion	2.06	5.99	0	0.77	3.66	0
R&D Intensification	355.26	1162.91	36.96	208.52	752.32	8.77
R&D Expansion	2.54	4.72	0.64	1.44	2.96	0.25
Market to R&D Intensification	184.59	602.89	4.82	110.95	470.12	3.21
R&D to Market Intensification	235.62	957.12	0	67.97	502.33	0
Biopharma	0.28	0.45	0	0.4	0.49	0
Sales Ratio	0.27	0.59	0.03	0.1	0.36	0
SIC Match	0.59	0.5	1	0.44	0.5	0
(Assets_a-Assets_t)^2	1.73E+09	4.36E+09	1.59E+07	1.77E+09	4.20E+09	1.73E+07
(ROA_a-ROA_t)^2	0.02	0.04	0	0.85	8.99	0.02
(BL_a-BL_t)^2	0.69	2.2	0.07	2.49	20.77	0.06

a. The acquirer's mean assets is 22,063, Std Dev 36,663, and Median 4,179 Million \$.

b. The acquirer's mean ROA is -0.004, Std Dev 0.06, and Median 0.02.

c. The acquirer's mean BL is 0.51, Std Dev 0.48, and Median 0.43.

¹² For example, if the deal took place in Jan 2002 and Inteleos shows that a target has a drug that was approved in May 2007, then I move backwards in time using the average duration of each phase and conclude that this drug most likely must have been in Phase 2 in Jan 2002.

I present the summary statistics of my sample separately for acquirers, chosen targets, and alternative targets in Table 1-7. The acquirers' size ranges from \$1.6 million to \$123 billion in assets. The target firms with median assets of \$186 million are relatively smaller than the acquiring firms with median assets of \$3.8 billion.

In general, acquirers are more profitable than targets and alternatives. The real targets have larger size, higher return on assets and lower book leverage (debt to assets ratio) than the alternative targets, suggesting that the real targets are financially healthier than the alternative targets on average. The real targets also score higher than the alternative targets on all the six synergy measures with acquirers, namely market intensification, market expansion, R&D intensification, R&D expansion, market to R&D intensification, and R&D to market intensification.

1.5.3 Measurement of Synergy

In this section, I discuss how I adapt the general framework mentioned in the previous section for calculating the synergies between the acquirer and the target alternatives. All notations refer to the method section.

I use the therapy class tree structure in Inteleos, which has 22,372 therapy classes organized into 10 levels of hierarchy. Since I do not have the distance between therapy classes in Inteleos, I assume that $\forall C_i \in C, d(C_i, C_i) = 0, d(C_i, C_i^{p,1}) = 0.5$ and $d(C_i, C_i^{p,n}) = 0.5n$ where $C_i^{p,1}$ is the immediate parent node and $C_i^{p,n}$ is the n level above parent node of C_i . I also assume that this distance is *symmetric*

($d(C_i, C_j) = d(C_j, C_i)$) and *additive*

($d(C_i, C_j) = d(C_i, C_i^{p,1}) + d(C_i^{p,1}, C_j)$ if $C_j \neq C_i^{p,n} \forall n$). These assumptions specify

every distance on the tree. To illustrate the distance calculation, in Figure 1-1,

$$d(C_6, C_8) = d(C_6, C_4) + d(C_4, C_8) = d(C_6, C_4) + d(C_4, C_2) + d(C_8, C_2) = 0.5 + 0.5 + 0.5 * 2 = 2,$$

where the first two equalities use the additivity assumption and the third equality uses

the assumption $d(C_i, C_i^{p,n})=0.5n$. Hence, $d(C_i, C_j)=1 \forall C_i \neq C_j$ that share the same immediate parent.

The mapping $l : D \rightarrow C$ is obtained from Inteleos which classifies each drug into one or more therapy classes. Since I do not have the data on drug sales, I proxy the market potential of each drug in the mapping $g : D \rightarrow R^+$ using the clinical probabilities of success in each phase of clinical trial¹³. In particular, approved drugs are given a market score of 1 and pipeline drugs in a given phase are given a R&D score equal to the clinical probability of approval for that phase.

The similarity factor $h: R^3 \rightarrow R^+$ in the intensification factor equations (1-1)-(1-4) is specified as:

$$\begin{aligned} h(d, s_x, s_y) &= \frac{1}{2^d} (s_x + s_y) \quad \text{if } d \leq 2 \\ &= 0 \quad \text{otherwise} \end{aligned} \quad (1-7)$$

The complementarity factor $r: R^2 \rightarrow R^+$ in the expansion factor equations (1-5)-(1-6) is given by:

$$\begin{aligned} r(d, s_z) &= \frac{1}{2} ds_z \quad \text{if } d \leq 2 \\ &= s_z \quad \text{otherwise} \end{aligned} \quad (1-8)$$

These functional forms imply that for $d \leq 2$, the similarity and complementarity factors are almost mirror opposite of each other in terms of sensitivity to distance; for $d > 2$, the complementarity factor is capped by s_z so as to not amplify the effect of market potential s_z on this factor whereas the similarity factor is discontinuous so as to maintain its opposite relation with the former factor.

¹³ Following Higgins and Rodriguez (2006), I study all the five phases of drug development namely Pre-clinical, Phase I, Phase II, Phase III, and Pending Approval. The clinical probabilities of approval in these phases are 0.07, 0.22, 0.30, 0.69, and 0.9 respectively.

1.5.3.1 An Illustration for the Calculation of Intensification and Expansion Factors

Assume that the therapy class structure is as given in Figure 1-2. Further assume that acquirer's and target's pipeline and approved drugs' therapy classes and their corresponding market and R&D scores are as given in Table 1-8.

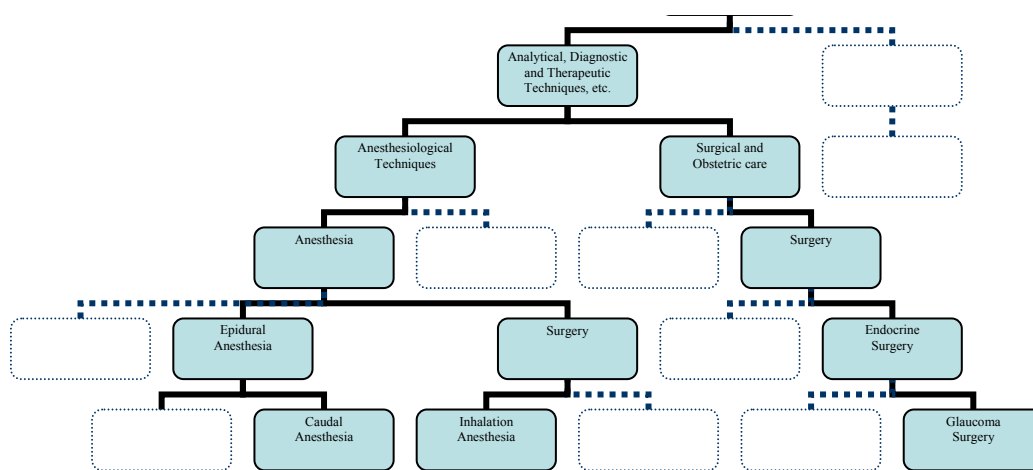


Figure 1-2: Example of Therapy Class Structure

Table 1-8: Example for Coding Representation of Therapeutic Classes in Figure 2-2

Therapy class	Market Score	R&D Score
Panel I: Acquirer		
glaucoma surgery	2	0.07095
caudal anesthesia	0	0.9
Panel II: Target		
glaucoma surgery	1	0.215
endocrine surgery	0	0.685
inhalation anesthesia	0	0.07095

In Table 1-8, the acquirer's market score of 2 for glaucoma surgery may arise because the acquirer has two approved drugs (each with a weight of 1) in this therapy class. Likewise, the acquirer's R&D score of 0.0795 for glaucoma surgery may arise

because it has one drug is in the pre-clinical phase (with its clinical approval probability of 0.0795). The similarity factors between therapy classes with acquirer's *pipeline* drugs and therapy classes with target's *pipeline* drugs are calculated in Table 1-9. The *R&D intensification factor* is 1.06323, the sum of similarity factors for each of the therapy class combinations in Table 1-9.

Table 1-9: Example for Calculation of R&D Intensification Factors

Therapy classes	Therapy classes with acquirer pipeline drugs	
	glaucoma surgery	caudal anesthesia
glaucoma	$(1/2^0) * (0.07095 + 0.215) = 0.28595$	$0 * (0.9 + 0.215) = 0$
endocrine	$(1/2^{0.5}) * (0.07095 + 0.685) = 0.5345$	$0 * (0.9 + 0.685) = 0$
inhalation	$0 * (0.07095 + 0.07095) = 0$	$(1/2^2) * (0.9 + 0.07095) = 0.2$

The similarity factors between therapy classes with acquirer's *approved* drugs and therapy classes with target's *approved* drugs are calculated in Table 1-10. The *market intensification factor* is 3, the sum of similarity factors for each of the therapy class combinations in Table 1-10.

Table 1-10: Example for Calculation of Market Intensification Factor

Therapy classes with target approved drugs	Therapy classes with acquirer approved drugs
	glaucoma surgery
glaucoma surgery	$(1/2^0) * (2 + 1) = 3$

The similarity factors between therapy classes with acquirer's *approved* drugs and therapy classes with target's *pipeline* drugs are calculated in Table 1-9. The *Market to R&D intensification factor* is 4.1136, the sum of similarity factors for each of the therapy class combinations in Table 1-11.

The similarity factors between therapy classes with acquirer's *pipeline* drugs and therapy classes with target's *approved* drugs are calculated in Table 1-10. The *R&D to Market intensification factor* is 1.0795, the sum of similarity factors for each of the therapy class combinations in Table 1-12.

Table 1-11: Example for Calculation of Market to R&D Intensification Factor

Therapy classes with target pipeline drugs	Therapy classes with acquirer approved drugs
	glaucoma surgery
endocrine surgery	$(1/2^{0.5}) * (2+0.685) = 1.8985$
inhalation anesthesia	$0 * (2+0.07095) = 0$

Table 1-12: Example for Calculation of R&D to Market Intensification Factor

Therapy classes with target approved drugs	Therapy classes with acquirer pipeline drugs	
	glaucoma surgery	caudal anesthesia
glaucoma surgery	$(1/2^0) * (0.0795+1) = 0.0795$	$0 * (0.9+1) = 0$

The complementarity factors for therapy classes with target's *pipeline* drugs are calculated in Table 1-13. The *R&D expansion factor* is 0.2422, the sum of complementarity factors for each of the target therapy classes in Table 1-13.

Table 1-13: Example for Calculation of R&D Expansion Factor

Therapy classes with target pipeline drugs	Complementarity Factors
glaucoma surgery	$0.5 * 0 * 0.215 = 0$
endocrine surgery	$0.5 * 0.5 * 0.685 = 0.1712$
inhalation anesthesia	$0.5 * 2 * 0.07095 = 0.07095$

The complementarity factors for therapy classes with target's *approved* drugs are calculated in Table 1-14. The *market expansion factor* is 0, the sum of complementarity factors for each of the target therapy classes in Table 1-14.

Table 1-14: Example for Calculation of R&D Expansion Factor

Therapy classes with target approved drugs	Complementarity Factors
glaucoma surgery	$0.5 * 0 * 1 = 0$

1.6 RESULTS

1.6.1 Conditional Logit Result

The conditional logit estimates are reported in Table 1-15. As compared to the estimation *without* the pipeline and market synergy variables (not reported, available

upon request), the full model estimation in Table 1-15 improves the McFadden's LRI (a goodness of fit measure) from 0.29 to 0.47 and the Adjusted Estrella (another goodness of fit measure adjusting for number of parameters) from 0.58 to 0.68. The likelihood ratio test shows that the improvement in log likelihood from -43.21 to -33.57 is statistically significant at 0.01 level (the chi square is 19.28 with 6 degrees of freedom). These results show that the market and R&D synergy variables increase the model's explanatory power significantly.

Table 1-15: Parameter Estimates for Conditional Logit

Parameter	Parameter Estimate	Std Err	t Value	Pr > t 	Hypotheses
Total Assets	4.51E-04	6.79E-04	0.66	0.51	
Return on Assets	4.73	2.55	1.86	0.06	
Book Leverage	-1.37	0.96	-1.42	0.15	
Market Intensification	-0.05	0.02	-2.36	0.02	H1
Market Expansion	0.04	0.14	0.31	0.76	H2
R&D Intensification	-0.02	0.01	-2.23	0.03	H3
R&D Expansion	0.05	0.07	0.69	0.49	H4
Market to R&D Intensification	0.03	0.01	2.42	0.02	H5
R&D to Market Intensification	0.04	0.02	2.52	0.01	H6
Alliance	29.84	4681	0.01	0.99	
Large	-54.8	30.26	-1.81	0.07	
SIC Matching	0.97	0.59	1.63	0.1	
Sales Ratio	0.39	0.52	0.74	0.46	
Biopharma Matching	-0.3	0.57	-0.52	0.6	

Notes:

a. Number of obs.: 29; Number of cases: 264

b. McFadden's LRI: 0.47. This is a goodness of fit analogous to the R^2 in the linear regression model. $R^2_M = 1 - [\ln L / (\ln L_0)]$ where L is the maximum of the log-likelihood function and L_0 is the maximum of the log-likelihood function when all coefficients, except for an intercept term, are zero. McFadden's likelihood ratio index is bounded by 0 and 1.

c. Adjusted Estrella: 0.73. Adjusted Estrella is another goodness of fit measurement suggested by Estrella: $R_{E2}^2 = 1 - [(\ln L - K) / \ln L_0] - (2 / N) \ln L_0$, where $\ln L_0$ is computed with null parameter values, N is the number of observations used, and K represents the number of estimated parameters.

The market intensification factor and the R&D intensification factor are negatively significant, implying that the acquirers shun targets that simply strengthen their existing markets or R&D base. Therefore H1 and H3 are rejected. The market to

R&D intensification factor and the R&D to market intensification factor are positively significant, implying that the acquirers prefer targets with either approved drugs that match their existing pipeline, or R&D products that match their existing products. H5 and H6 are supported.

The positive significance of R&D to market intensification (H6) suggests that acquirers seek to achieve immediate revenue growth by establishing presence in markets of strategic interest and generate synergy by exploiting the acquired knowledge to improve its R&D. The acquirer's pipeline reflects its belief in the marketability of those drugs in the future. However, the acquirer may not want to wait for the slow R&D process to deliver if it is eager to enter that market. Therefore, the acquirer may choose a target which possesses approved drugs that match the pipeline it is developing. The acquirer can generate synergy by exploiting the knowledge gained from the acquired products to improve its delayed R&D project or create new knowledge.

The positive significance of market to R&D intensification (H5) suggests that acquirers' seek to boost their long-term innovation potential and generate synergies from pipeline to product transformation. An acquirer may want to replenish its pipeline even when its current drugs are generating revenue because current drugs may suffer a loss in revenues once the patent expires, thus resulting in production shutdowns and sales force layoffs. So the acquirer may want to acquire pipeline drugs that could get approved by the time its current drugs run out of patent, and can utilize the existing sales force and production capacity. Danzon, Nicholson and Pereira (2005) found that pharmaceutical companies with more experience in drug development are more likely to take large and complex late-stage trials to success. The acquirer can use its experience and resources to help carry those R&D projects through the final stages besides providing valuable pre-launch and post-launch support in areas such as

production, marketing and sales coverage. Also, an experienced pharmaceutical acquirer can help the target in the FDA's New Drug Application process, which takes an average of 20 months (Berndt 2001).

The above two motives (R&D to market intensification and market to R&D intensification) have different planning horizon, with the first one aiming at immediate revenue generation and the second one aiming at promoting innovation to generate revenues few years down the road. Therefore, both considerations can exist in the same deal if the acquirer's pipeline is in some therapeutic areas and its products are in other therapeutic areas. Alternately, the significance of these two motives could be because different deals focus on one of these motives. Unfortunately, the small sample size restricts the further splitting of the sample, since each subset will have too few observations to make the estimation outcome significant.

The negative significance of market and R&D synergies (H1 and H3 respectively) in my estimation doesn't necessarily contradict the positive results in the empirical literature on "related" mergers (e.g. Amihud and Lev 1981). Instead, the differences may be driven by the degree of "relatedness". The cross-industry studies on "relatedness" consider all firms in the same industry as related whereas I capture the "relatedness" within an industry. So the findings in the literature may hold that mergers in the same industry are more likely to create synergy, but within an industry, it seems the acquirers don't want targets that are similar to themselves. The bell shaped effect between relatedness and synergy (Prabhu, Chandy and Ellis 2005) might peak at the boundary of the industry, and generate the results found in the literature and in this paper.

I do not find significant evidence for the market and R&D expansion factors (H2 and H4 respectively). This finding does not necessarily mean that the acquiring firms do not use acquisition as an expansion tool. Instead, it might be that acquirers

have certain aims in their market or R&D expansions. In particular, R&D to market intensification is a subset of R&D expansion because the complementarity of target's R&D to acquirer's R&D doesn't preclude the possibility that the target's R&D could be similar to acquirer's markets. Using the same logic, market to R&D intensification is a subset of market expansion. Since the acquirer needs expertise in the area that it wants to enter to assimilate the new products and knowledge, it may want to expand in areas that it is familiar with (positive significance of interaction synergies) instead of expanding in totally new areas (lack of significance of expansion synergies).

As for the other variables, none of the culture matching variables turn out to be significant. This is more or less expected, because "culture" of a firm is always difficult to define, not to mention quantify. The return on assets of the target firm is a significant factor for target selection. Obviously target firms with higher returns are more attractive to acquirers. Targets greater than 10 billions are less likely to be selected, which confirms my conjecture that challenges specific to large firm acquisition such as difficulty in integration and culture shock hold back acquirers from acquiring these large targets.

1.6.2 Bootstrapping Test

I conduct a bootstrap study pioneered by Efron (1979) to verify the robustness of my findings. Following the standard bootstrap procedure in Mooney and Duval (1993), I draw 1000 times, 29 observations with replacement from the original sample, and calculate summary statistics for the 1000 parameter estimates. Table 1-16 contains the mean, median and confidence interval of the parameter estimates. My findings from the main estimation regarding market and R&D synergies hold in the Bootstrap study.

Table 1-16: Bootstrap Analysis

Parameters	Mean	Median	5th percent	95th Percent
Total Assets	-4.98E-03	0.00	-0.00333	0.00273
Return on Assets	45.79	6.08	1.02	28.3
Book Leverage	-3.87	-2.39	-8.27	-0.6
Market Intensification	-0.46	-0.08	-0.5	-0.03
Market Expansion	0.14	0.02	-0.41	0.76
R&D Intensification	-0.09	-0.02	-0.06	0
R&D Expansion	0.06	0.02	-0.24	0.37
Market to R&D Intensification	0.18	0.03	0.01	0.13
R&D to Market Intensification	0.33	0.06	0.03	0.26
Alliance	118.93	33.26	21.1	120.52
large -	-149.78	-62.41	-303.52	214.6
SIC Matching	3.24	0.98	-0.29	2.81
Sales Ratio	22.15	0.36	-1.62	8.89
Biopharma Matching	-2.78	-0.59	-2.65	0.36

1.6.3 Predictive Power

I do the following analysis to test the out of sample predictive power of the model: 1) remove 2 deals from the 29 deals , 2) run the conditional logit estimation with the remaining 27 deals and estimate the parameters, 3) use the parameter estimates to predict the target for the two deals that were dropped from the estimation sample, 4) record the accuracy of the prediction, and 5) repeat steps 1-4 for all possible combinations of 2 deals out of 29, which is 406 in total (I use 2 deals instead of 1 in each round, because the former gives us a much larger sample for statistical testing). With the six markets and R&D synergy variables, the accuracy of the model prediction is 54.56%, whereas the accuracy without these synergies is 44.46% (the difference is statistically significant at 0.01 level). The chance of random selection is 10%. This test shows that the model does a significantly better job than chance in predicting target choice. And the inclusion of market and R&D synergies improves the

model's predictive power significantly as compared to having financial variables alone.

1.6.4 Tests for Nonlinearity of R&D and Market Intensification

I include the square term of the R&D intensification factor together with the first order term in the estimation to see whether a bell-shaped effect of the R&D intensification factor exists¹⁴. The effect of R&D intensification does not change: neither the first order term nor the squared term is significant. However, the effect of market intensification changes with the inclusion of its square term: the market intensification factor is positively significant and its square term is negatively significant. This result may be arising due to the positive correlation between the pipeline and approved drugs of the acquirers. To test this conjecture, I include the market and R&D intensification and expansion factors together with the squared term of the market intensification factor in the estimation. The market intensification factor is negatively significant and the square term is not significant, confirming my conjecture that correlation is driving the non-monotonic effect of market intensification in the earlier estimation.

1.6.5 Test for Financial Synergies

To verify the effect of financial synergies proposed by Rao et al. (1991), I include the dispersion of financial variables of the acquirer and target alternatives in the main estimation. My findings from the main estimation are unchanged in this new specification. And none of the financial synergy variables is significant (results not reported, available upon request). The goodness of fit measured by McFadden's LRI increases from 0.47 to 0.49, which means that the financial synergy variables increase the explanatory power; however, the Adjusted Estrella decreases from 0.73 to 0.67 after the increased number of independent variables are taken into account. While the

¹⁴ Results not reported, available upon request.

financial synergy may explain some of the “fit” between acquirers and targets, my market and R&D synergy variables are much more refined measures of synergy between the merging firms, and therefore overshadow the significance of financial synergy.

1.7 DISCUSSION AND IMPLICATIONS

My findings provide considerable support for the knowledge based view of the firm. Knowledge, in the form of product knowledge and R&D knowledge, is a strong motivation for acquisition target selection. This point has been suggested by the competence based theories of the firm (of which knowledge based view of the firm is a subset) and has had a strong influence on the M&A literature (e.g. Hamel and Prahalad 1994, Haspeslagh and Jemison 1991). As the organization is dependent on the current and aspired configuration of capabilities, these capabilities influence the extent of mergers and acquisitions by determining the boundaries of the firm and acting as the first and foremost decision-making determinant in the M&A due diligence process. Even more generally, resource endowments and synergy seeking can be argued to influence pre-merger processes like growth strategy selection, candidate selection, strategic and financial due diligence as well as negotiations. In this empirical study I find concrete support for this school of thought.

Although this research is conducted in the pharmaceutical industry, the findings can be generalized to many high tech industries that emphasize on innovation and have frequent consolidation through acquisition. For example, similar acquisition patterns can be found in the information technology industry where firms such as Microsoft, Google and Cisco have acquired successful products in new markets where these giants wanted to enter (for instance, Google acquired the popular “You Tube” while its “Google Video” was struggling to enter this market).

This research can help managers in several ways. It provides the acquiring firm a viable tool to quantify its potential synergy with a target. The manager's qualitative guidelines of "strategic fitness" can be quantified using my synergy measures and the fit with different potential targets can be compared to choose the best target. Managers can enhance my synergy measures by including more variables such as geographic regions, market shares, sales figures, sales force expertise, distribution coverage, and management and scientific personnel. Better measures for cultural fit can also be included in anticipation of the integration process. Also, the framework in this paper can be adapted by executives to make other business to business relationship decisions such as the choice of an advertising agency.

1.8 LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

There are several limitations of this paper. First, since the reasons for acquisition often differ across industries, certain effects in a single industry study may not hold in cross industry studies. Therefore more empirical studies are needed with data from industries with different levels of reliance on innovation. Second, within my application context, I do not have detailed information on production facilities, sales force, market share, etc. Although my synergy measures serve as a proxy for these operational factors, including these explicit measures can verify the findings in this paper. Third, as in most empirical studies, I assume the same acquisition incentive across deals. It is possible that different acquisitions are conducted for different reasons, even within the same industry. With a larger dataset and more readily available pipeline and product information, one can test more refined hypotheses on acquisition incentives specified by acquirer types. For example, this heterogeneity in incentive can be introduced through acquirer specific parameters with different distributional assumptions and estimated through Hierarchical Bayesian methods.

As for future research, my choice modeling in an acquisition context can be extended by researchers to study other managerial decisions in the Business to Business context, such as alliances and joint ventures, where the needs of both the initiator and the recipient are to be considered, and the best results can be achieved through synergy creation. The model can also be generalized by researchers in many non-business settings, such as dating and social networking.

This paper also suggests a new direction for the empirical acquisition literature. Instead of studying the acquisition outcome unconditionally, this paper suggests that it might be better to condition the outcome on acquisition motive. The knowledge of acquirer's motive can help in deciding which aspect of acquisition outcome to evaluate. For instance, if an acquirer chooses a target whose pipeline can deliver products in 5 years time, it is not useful to evaluate the acquisition based on earnings growth in a shorter duration such as 3 years. Controlling for target selection in the acquisition outcome can also help in ascertaining the impact of integration process because the inability of achieving the acquirer's initial motives must be due to an unsuccessful integration.

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CHAPTER 2

MEASURING THE IMPACT OF MERGERS ON INNOVATION WITH A MATCHING MODEL

2.1 ABSTRACT

Innovation is one of the key motivations for mergers and acquisitions (M&A). While many studies have explored the effect of M&A on innovation output, these studies do not control for the endogenous matching between the acquirer and the target, which not only obscures the effect of integration on innovation performance, but also yield biased estimates of the drivers of innovation output. Therefore, I study the impact of M&A on innovation using a two stage model: a matching model is used to explain the sorting of firms into pairs, and an innovation output function is linked to the matching model through error correlation. This joint specification reduces the bias in estimation of innovation outcome and helps determine the drivers of merger integration process. Using a Bayesian estimation method, the model is applied to 1895 mergers in five high-tech industries between 1992 and 2008. I find that the unobserved strategic fit between the two merging partners has a significant effect on the post-merger innovation abilities of the combined firm. Managers wisely choose merger partners that deepen their technical knowledge, but underestimate the challenges in integrating foreign partners and partners with similar technology. I also find potential bias in the effect of knowledge breadth on post-merger innovation performance in the existing literature due to matching induced endogeneity.

2.2 INTRODUCTION

Innovation is central to marketing discipline. Often, it is a central motivation for mergers and acquisitions¹⁵ (Sorescu et al, 2007). Consequently, many researchers have explored the link between merger and innovation. While initial research mostly from the strategy literature suggested that mergers tend to hurt innovation due to integration distractions, scientist turnover, or R&D budget reductions (Hitt et al. 1991; Hitt et al. 1996; Ernst and Vitt, 2000), many recent studies suggest that mergers can assist innovation (Ahuja and Katila, 2001; Prabhu, Chandy and Ellis, 2005; Sorescu, Chandy and Prabhu, 2007). Specifically, firms with strong internal knowledge (depth, breadth and similarity of knowledge) produce more innovation from acquisition (Prabhu, Chandy and Ellis, 2005) and acquirers with large product capital (product development and product support) are better able to select and deploy target's innovation potential (Sorescu, Chandy and Prabhu, 2007).

While the acquirer's internal knowledge and product capital may influence the innovation output in an acquisition, it is not clear how much of this influence comes from *generating* innovation synergies or from *facilitating* the integration process. This ambiguity arises because the existing empirical studies directly estimate the impact of relevant variables on post-merger innovation output without controlling for the *endogenous matching* between the acquirer and the target. Ignoring the matching process not only obscures the effect of integration on the outcome of the merger, but may also yield biased estimates of the determinants of post-merger innovation output if unobserved variables affect both matching and outcome of a merger.

In this paper, I control for the endogenous matching of merging firms to estimate the influence of various drivers of innovation output in a merger. I use a structural matching model to explain the sorting of firms into merging pairs, and then evaluate

¹⁵ Mergers, acquisitions and M&A are used interchangeably in this paper.

the innovation outcome of the merger based on the matching process. This joint specification reduces the bias in estimation of innovation outcome and helps determine the drivers of integration process. A Bayesian method is employed to estimate the model.

The model is estimated on 1,895 deals from five high-tech industries. The joint estimation significantly improves upon OLS in explaining the innovation output in a merger. I find that *unobserved strategic fit* in a merger has a strong effect on post merger innovation abilities, measured by post merger number of new patents produced by the firms. Moreover, the joint estimation uncovers many new facts about innovation outcome, merger matching and merger integration. First, I find that similarity of knowledge non-monotonic and positively affects partner choice and negatively affects merger innovation output, suggesting that managers do not prefer to merge with too similar firms and fail to fully anticipate the problems in integrating firms with similar knowledge base. Second, depth of knowledge is non-monotonically related to both matching and innovation outcome, suggesting that managers prefer firms with intermediate knowledge depth and that managers tend to anticipate the effect of knowledge depth on innovation performance. Third, breadth of knowledge has a marginal positive significance on innovation performance but has no effect in the matching estimation or the OLS estimation. This finding suggests that managers do not anticipate the effect of knowledge breadth on merger, and the OLS estimate of the effect of knowledge breadth is biased due to matching induced endogeneity. Similar results hold with respect to the nation matching between acquirer and target firm. Managers prefer foreign firms to domestic partners, yet the domestic partners generate better results according to post merger performance measures.

Synergies in a merger can be generated in two stages. The first stage is the matching process, wherein the two firms find each other as ideal partner for synergy

generation. The second stage is the integration process, during which the two firms work together to realize the potential synergy. Since the factors that affect matching and the factors that influence the integration process may overlap, it is important to empirically separate the two effects and measure their relative importance. The extant literature is not able to differentiate between these two contributors to synergy in the same model. In contrast, I separate these two effects through a two-part modeling framework which captures the choice of merger partner in the first part and estimate the merger outcome in the other.

When two firms choose to merge, they might aim at potential synergies which can be realized if the integration process runs smoothly. However, problems in the integration process often prohibit the realization of all the potential synergies. Therefore, the expected synergies from a merger must be equal to the potential synergies from that merger minus the expected synergy lost through the integration process. It is reasonable to expect that firms choose a merger partner based on expected synergies as evaluated by managers. However, managers' expectations of integration success may be biased either due to incomplete information or due to overconfidence. Therefore managers' expected synergies may be higher than the true expected synergies and the difference between these two expectations represents expected integration problems not anticipated by the managers. Since merger matching is based on managers' expected synergies whereas realized synergies are distributed around the true expected synergies, the matching part of my model estimates the drivers of managers' expected synergies whereas the outcome part of my model estimates the drivers of true expected synergies. Subtracting these two estimations gives the drivers of integration problems that should have been anticipated by managers if they had complete information and were perfectly rational.

Besides estimating the effects of drivers of integration process, my model also corrects for matching induced endogeneity in estimating the true drivers of innovation output. In a merger, the matching process becomes endogenous when an acquirer and a target match not only on observable innovation characteristics but also along dimensions that are unobserved in the data. The error term in the matching model for the merged pairs, which captures the merger fit on unobservable dimensions, becomes correlated with the observable innovation characteristics¹⁶. If the unobservable characteristics also affect the innovation output, the estimated coefficients from a direct regression of observed characteristics on innovation output (which is used in the extant M&A literature) are biased relative to the actual influence of the observable characteristics on innovation output.

One interpretation of the unobserved characteristics for matching is that it represents unobserved or idiosyncratic strategic fit. According to Porter (1996), competitive advantage comes from coordinating all the activities in a firm to achieve strategic fit. Therefore when firms merge with others, they will seek partners that can strengthen and deepen their strategic fit (Porter 1987). Strategic fit defined in terms of observable characteristics such as product-market relatedness (Porter 1987), resource allocation patterns (Harrison et al. 1991), management philosophy (Datta, Grant, and Rajagopalan 1991) and organizational culture (Chatterjee et al. 1992) has been used to explain post-merger outcomes (Ramaswamy 1997). However, some of the factors that affect strategic fit, such as supply channels, sales force distribution, research personnel, and technical expertise are either not publicly available or hard to collect. Matching on such unobservable characteristics may represent unobserved strategic

¹⁶ If the observed and unobserved characteristics are correlated to begin with, the matching process increases the correlation between the observed and unobserved variables for the matched pairs.

fit¹⁷. Moreover, factors such as the leadership style and corporate culture are firm specific and cannot be compared across mergers. Matching on such idiosyncratic characteristics may represent idiosyncratic strategic fit. The matching of firms on unobservable dimensions has also been referred to as private synergy (Hitt et al. 1991).

One solution to the endogeneity problem is to estimate the model using instrumental variables. For each merger, the instrument must be independent of the merger outcome but related to the fit of the merging firms. Unfortunately, any of the merging firms' characteristics that are related to the merger decision also have an impact on the merger outcome and hence are not valid instruments.

Since instruments are hard to find in this case, I develop a structural model to separate the effect of factors that determine matching from those that influence integration. Matching in the merger market implies that a firm chooses a partner with the best fit subject to the partner not wanting to merge with some other firm. Hence the merger decision depends on the characteristics of other firms in the merger market. However, the outcome of the merger is independent of the characteristics of the alternative firms. Therefore, the characteristics of the alternative firms in the merger market present a source of exogenous variation in the model¹⁸. This exogenous variation is similar to an instrumental variable, and the structural model uses it to identify the two sources of synergy. Researchers have introduced such exogenous variation to overcome endogeneity in other economic settings (e.g. Bresnahan 1987, Berry, Levinsohn, and Pakes 1995). Sorensen (2007) uses a similar model to

¹⁷ A researcher could use proxies or managerial inputs to control for these unobserved factors, but these controls tend to be imprecise and subjective.

¹⁸ Obviously this model does not apply to situations where mergers trigger or result from industry wide consolidation or major landscape change. To study the mega mergers and their consequences on the entire industry, a different game theory model with fewer players will be more appropriate. In my study I excluded the top 1% of the firms (by size) from my sample, so this concern is alleviated to some extent.

overcome endogeneity in the matching of venture capitalists and start-up companies, although the sources of endogeneity in Sorensen's and mine model are quite different.

My structural model consists of two parts. The second part specifies the outcome of each merger deal. Due to matching-induced endogeneity, estimation of this equation alone yields inconsistent estimates. The first part of the model specifies a merger matching game, which is based on a one-sided matching model called *roommates model* (Gale and Shapley 1962)¹⁹. Angelov (2006) adapts the roommate model to the merger situation under the assumption of extreme value distribution, which simplifies the derivation of equilibrium but restricts the application of the model to few participants in each market. I adapt the roommate model under the assumption of normal distribution, which allows any number of participants in each market but requires a more sophisticated estimation procedure. The empirical matching model is a discrete choice model that allows for interactions among the choices made by different agents. Together, the two parts of the model are analogous to the two stages of the two-stage estimator in the Heckman selection model (Heckman 1976, 1979). Since the estimation is numerically intensive, I use Bayesian estimation based on MCMC simulation called Gibbs sampling (Gelfand and Smith 1990, Geweke 1999). This estimation procedure is similar to the procedure used by Sorensen (2007), who estimates a college admissions model. The difference in this case is that my model a roommate matching model.

This paper makes several contributions to the literature. First, it identifies the exact contribution of various drivers of innovation output in an acquisition. While the existing literature has identified such drivers (e.g. Prabhu, Chandy and Ellis, 2005;

¹⁹ Since merging firms cannot always be naturally divided into two subgroups beforehand and because the motivations of merging firms in pursuing a merger may be similar, two-sided matching models such as marriage model or college admissions model (Roth and Sotomayer 1990) are not suitable for analyzing the merger game.

Sorescu, Chandy and Prabhu, 2007; Cassiman et al. 2005), these studies do not identify which of those variables affect merger matching and which affect the integration process. Moreover, the results from existing studies are biased due to matching induced endogeneity. After correcting for these problems, I find that unobserved strategic fit in a merger has a strong effect on post merger firm innovative abilities. Merging firm managers wisely chose partners that will deepen their technical knowledge, but are underestimating the integration challenges brought by foreign partners and partners with similar technology as theirs. I also find that the estimation of breadth of knowledge in the existing literature is biased due to matching induced endogeneity.

Second, this paper pioneers the method for quantifying and estimating the empirical determinants of merger integration process. The existing empirical M&A literature studies the determinants of merger outcome (e.g. Loughran and Vijh 1997; Andrade, Mitchell and Stafford 2001; Prabhu, Chandy and Ellis, 2005) but not the drivers of the integration process. The research on integration process has relied on case studies and manager surveys rather than objective empirical analysis²⁰. By developing a structural model that links merger matching and merger outcome, this paper quantifies the drivers of integration process. The findings can be used by managers and academics alike.

Third, this paper develops a new method for studying unbiased determinants of merger outcomes such as innovation output, stock returns and operating performance. Merger involves endogenous matching of firms which, unless controlled for, biases the impact of relevant variables on merger outcome. This paper develops a game theoretic model to endogenize the merger partner choice and estimate the unbiased

²⁰ There exists a large literature on the determinants of merger integration process (e.g. Homburg and Bucerius 2005), but these papers are based on subjective case studies and manager surveys rather than objective empirical data.

impact of relevant variables on the merger outcome. To my knowledge this is the first study to identify and correct matching induced endogeneity in a merger setting. M&A literature which evaluates long-term merger performance can use this model to obtain unbiased estimates of merger outcome. Marketing, finance and strategy literature which evaluates long-term merger performance (e.g. Loughran and Vijh 1997; Andrade, Mitchell and Stafford 2001) can use this model to understand how integration process affects merger performance.

Fourth, this paper generalizes the existing literature on M&A target selection. The existing studies on merger partner choice (e.g. Silhan and Thomas 1986; Rao, Mahanjan and Varaiya 1991; Yu and Rao 2009) consider the merger process solely from the perspective of acquirers, as if target firms have no say. In reality, majority of mergers happen with the consent of both participants. Often times there are more than one interested acquirers and target firm have to make a choice. This paper uses a matching model to specify the target selection process, and therefore improves upon these studies. Moreover, these studies do not evaluate the impact of merger matching on merger outcome as this paper does.

Fifth, the model developed in this paper can be adapted to many marketing situations which involve matching and performance evaluation. Some examples include firm's selection and evaluation of advertising agencies, firm's selection and evaluation of wholesale distributors, firm's selection and evaluation of suppliers etc. Direct evaluation of performance in these cases without controlling for matching will lead to biased estimates. Using a matching model to control for matching induced endogeneity will lead to unbiased evaluation of performance in these settings. The Bayesian estimation of roommate model introduced in this paper can be adapted for estimating such models.

2.3 THEORY AND LITERATURE REVIEW

2.3.1 Theory

With the rise of the competence based perspective to corporate strategy (e.g. Hamel and Prahalad 1990, 1994, Rumelt, Schendel and Teece 1994) and a more elaborate understanding of the need for **strategic and organizational fit** (e.g. Porter 1996), the relatedness of activities has received extensive and increasing attention (Parvinen 2003).

According to Porter (1996), competitive advantage comes from strategic positioning, and coordinating all the activities in a firm to achieve *strategic fit*. Similarly, when firms merge with other firms, they will seek partners that can strengthen and deepen their *strategic fit*, and therefore create synergy in the process (Porter 1987). Although some fit among activities is generic and applies to many companies, the most valuable fit is strategy-specific because it enhances the uniqueness of a firm's strategic position and amplifies trade-offs among its activities²¹. Therefore, the *strategic fit* sought in merger is also unique to each case and cannot be simply lumped into several large categories. Otherwise the strategies become similar within the categories and the firms who own them would not have unique positioning or advantage among the peers.

Because competitive advantage grows out of the entire system of activities of a firm, it is misleading to explain success by specifying individual strengths, core competencies, or critical resources without considering the consistency of the entire collection of the company activities. This further reinforces my earlier point that controlling for the characteristics of acquirer or target alone cannot explain the

²¹ Firms that want to hold a specific strategic position in the market have to make trade-offs in the activities they pursue. For example, a firm that wants to focus on business customers rather than retail customers may restructure its business process so that it serves the former customers better at the expense of the latter customers.

potential synergy between acquirer and target, or why two firms merge with each other. The fit between two firms may be unique to each merger and cannot be replicated or grouped easily with other mergers. In other words, mergers could be driven by *idiosyncratic strategic fit* between the activities of the two firms. Such idiosyncratic fit may not even be disclosed to outsiders due to competitive reasons, resulting in private synergies (Hitt et al. 1991).

With the theory of *strategic fit*, I move on to the measurement of *strategic fit*. Since the early development of the strategy school, scholars have paid attention to the relationship between related activities and merger synergy. In general, the findings show that related mergers outperform the diversifying ones (Kitching, 1974; Nelson and Winter, 1982; Singh and Montgomery, 1987; Porter, 1987). Besides the product based definition of relatedness, later studies from the strategy school also encompass critical organizational and strategic factors such as resource allocation patterns²² (Harrison, Hitt, Hoskisson, and Ireland 1991), management philosophy (Datta, Grant, and Rajagopalan, 1991) and organizational culture (Chatterjee et al. 1992; Jemison and Sitkin 1986; Nahavandi and Malekzadeh, 1993) in explain post-merger outcomes (Ramaswamy 1997). These empirical studies provide evidence for specific components of strategic fit. For example, Swaminathan, Murshed and Hulland (2008) prove the effect of strategic emphasis alignment on post-merger outcomes. Chatterjee et al. (1992) find that “cultural fit” between the target and competing acquirers on dimensions such as risk-taking attitude, reward orientation, innovation orientation, and autonomy orientation results in superior gains for the stockholder. They find that cultural mismatches harm the performance of the mergers. Along similar lines, Datta et al (1991) find that inconsistency between the acquirer’s and target’s management

²² The argument for strategic alliance is that if two firms exhibit very similar resource allocation patterns as measured across a variety of strategically relevant characteristics (e.g. , risk propensity, marketing efficiency), they can be considered to be strategically similar.

styles was negatively related to post-merger performance. They reason that when mergers require an amalgamation of dissimilar management styles, a firm loses its ability to act in unison to realize the potential synergies arising from the merger, leading to poor performance. Ramaswamy (1997) measures relative size, pre-merger performance, market coverage, overhead/revenues, marketing expenditures/revenues, client mix and risk propensity on a group of bank mergers and finds that everything except relative size and market coverage are negatively correlated to the post merger performance of the acquirer firm.

From the above theoretical and empirical evidence, I can draw the conclusion that strategic fit between the acquirer and the target plays an important role in post-merger performance. There might be other factors that affect strategic fit such as complementary business offerings, supply channels, sales force distribution, etc. (Rao et al. 1991) that are important in practice but are difficult to measure or obtain data on. Even if the data on these factors can be collected on a small scale, they are difficult to obtain on a large scale which is often desired for robust and generalizable empirical analysis. Besides, as discussed earlier, strategic fit is often either idiosyncratic and therefore can not be pooled for many firms, or is privately observed and hence cannot be included in the analysis. To sum, the existing measures of strategic fit do not capture the true synergies in a merger.

Moreover, the method of measuring the influence of acquirer and target relationship on post-merger performances is flawed. According to the process theory of M&A (Hunt 1990, Haspeslagh and Jemison 1991, Pablo 1994, Larsson and Finkelstein 1999), merger performance not only depends on the planning and partner selection process, but also on the post-merger integration effort, which is often overlooked by researchers and practitioners.

According to Haspeslagh and Jemison (1991), during the merger planning stage, due to the time pressure and managers' incentive to justify the deal, the quality of the target selection process is often compromised. Therefore, following the decision to merge, costly mechanisms and the adjustment of information flows governing the use of the resources are needed (Ranft 1997, Zollo 1998, Zollo and Singh 2000). "The value to be derived from an acquisition depends largely upon the skill with which the administrative problems of integration are handled. Many valuable acquired corporate assets have been lost by neglect and by poor handling during the integration process" (Mace and Montgomery 1962, p.230, in Haspeslagh and Jemison 1991, p.307).

Table 2-1: A Classification of the M&A Process into Three Phases According to Emerging Process Problems (Marks and Mirvis 1998)

Phase	Problem
Pre-Combination	Unclear business strategy Weak core business Poor combination strategy Pressure to do a deal Hurried due diligence Overvalued targets and overestimated synergies, prospects and returns
Combination	Integration seen as distraction from "real work" Misunderstood value added and critical success factors Psychological effects denied or ignored Culture clash denied or ignored
Post-Combination	Renewed merger syndrome Rushed implementation Insufficient resources deployed Unanticipated implementation obstacles Coordination snags Inattention to team building Culture by default, not by design Unintended impact on employment attitudes and hence business performance Missed opportunities for organizational enhancement

Table 2-1 above summarizes the issues at each stage of the merger process. As this table from Marks and Marvis (1998) suggests, the linkages between acquirer and target measured by the strategy literature does not account for all the interactions between the two firms after they tie the knot. And there is a need to separate the effect of integration process in empirical analysis. However, data on integration process is

notoriously difficult to collect due to the asymmetry of inside and outside information, and uniqueness of each merger. In this paper, I use a structural model to separate the effect of these two stages, namely the strategic fit seeking partner selection (matching) stage, and the post-merger integration stage. Admittedly there is carry-over effect from the matching stage, since good managers always try to foresee the difficulties and opportunities of integration and take those into account while choosing their merger partner. Therefore the effect of second stage measured by my model will be the residual influence of integration after the effect of first stage matching is taken into account.

An alternate way to view the above issue is that managers enter into a merger based on expected synergies from the deal. These expectations take into account integration problems to the extent that managers can anticipate those problems. If the managers had complete information and were perfectly rational and act to maximize the shareholder value, the realized synergies from the merger should be evenly distributed around their expected synergies. Otherwise, their expectations may be biased as compared to average realized synergies. The source of this bias can either be incomplete information, misjudgment, or agency problems. The structural model in this paper jointly specifies the expected synergies in the merger matching stage and the realized synergies in the merger outcome stage. The differences in the parameter estimates for these two stages capture the merger integration issues that were not reflected by managers' expectations.

One aspect of the merger performance, which is of special importance to marketing scholars, is innovation abilities. As stated by Prabhu, Chandy and Ellis (2005), many firms consider the acquisition of other firms as a way to co-opt and build on ideas from outside. Acquisitions are especially prevalent in high-tech industries, in which the level of market and technological uncertainty is high and the need to absorb

new ideas through acquisition is high (John, Weiss, and Dutta 1999; Rindfleisch and Moorman 2001; Wind and Mahajan 1997). A strategy based solely on internally built knowledge is likely to delay or inhibit access to these ideas—sometimes with fatal consequences. For these and other reasons, marketing scholars have highlighted the potential for innovation through acquisitions (Wind and Mahajan 1997).

On the other hand, some strategy researchers have argued that acquisitions tend to hurt, not help, innovation (Ernst and Vitt 2000; Hitt et al, 1991; Miller 1990). They argue that the activities involved in trying to consummate and integrate acquisitions can distract managers from the task of innovation (Hitt, Hoskisson, and Ireland 1990). Others note that key employees, including scientists and champions of innovation, may leave the firm after acquisition (Ernst and Vitt 2000). Researchers also point out that firms may take on considerable debt to finance acquisitions; the interest expenses and repayments associated with this debt may choke off much-needed funds from innovation (Hitt et al. 1991b).

Therefore, the effect of acquisition on innovation is an open question and can be answered with sound empirical analysis. The mixed empirical evidence on this issue is discussed in the next section. This paper adds to this literature by attempting to reduce the matching-induced bias in the estimates of effects of the drivers of innovation output and determining whether such influence comes from the strategic planning reflected in partner selection, or from the post-merger integration. Such distinction has significant implications on the understanding of M&A researchers, as well as the managers and consultants who plan or give advice on M&A deals.

2.3.2 Literature Review

As a phenomenon with large economic and managerial implications, merger and acquisition has been the focus of attention in many academic fields. Parvinen (2003) provides a comprehensive review on the theoretical background of mergers and

acquisitions. Weston, Mitchell and Mulherin (2003) provide a comprehensive review of the empirical findings on mergers and acquisitions.

Almost all the empirical research in this area focuses on merger outcome. These studies differ in how they measure merger performance. The most popular method to measure merger outcome is the “event study” method, which uses stock market values in an “event window” of 1-5 days. This stream of literature finds that the combined returns of acquirer and target are positive around the event window, indicating that mergers are synergy generating in general (Bradley, Desai, and Kimi 1988; Kaplan and Weisbach 1992; Servaes 1991; Mulherin and Boone 2000; Andrade, Mitchell and Stafford 2001). This result provides support for the positive correlation²³ between the matching and outcome function in my model design. Another stream of literature has measured merger outcome using long-term stock price performance and has found contradictory results. Some of these studies find the post-merger long-term price performance to be negative (Loughran and Vijh 1997), which is argued to be consistent with managerial hubris (Roll 1986). On the other hand, other studies find that the post-merger long-run price performance is insignificantly different from zero (Rau and Vermaelen 1998), which is argued to be consistent with the efficient market theory (Mitchell and Stafford 2000). The last stream of research measures merger performance using post-merger operating performance. Healy, Palepu and Ruback (1992) and Andrade, Mitchell and Stafford (2001) show that operating cash flow of a merged firm increases relative to industry benchmarks. This paper follows the last stream of research, because real business growth, profitability and innovation are of greater interest to marketing strategy researchers. While the stock market prices also depend on these measures of operational performance, but at the same time there are

²³ In the main specification I restrict the correlation between matching and outcome model to be between 0 and 1. I also estimated an alternative model without any restriction on the error correlation. The parameter estimate still turned out to be within (0,1) range.

many other factors that affect stock price that are beyond my ability to measure and control for.

While most of research on M&A has focused on merger outcome, several studies have explored target choice in acquisition setting (Silhan and Thomas 1986, Kroll and Caples 1987, Schniederjans and Fowler 1989, Rao, Mahanjan and Varaiya 1991; Yu and Rao 2009). Except for Yu and Rao (2009) which is an empirical study, the remaining are either simulation studies or survey-based researches which lack objective empirical validation. Moreover, all these papers consider the merger process solely from the perspective of acquirers, as if target firms have no say. In reality, majority of mergers happen with the consent of both participants. Often times there are more than one interested acquirers, and target firm have to make a choice. This paper uses a matching model to specify the target selection process to incorporate these situations.

In the empirical M&A literature, merger integration has received little attention. While there exists a large literature on the determinants of merger integration process (e.g. Homburg and Bucerius 2005), these studies are based on subjective case studies and manager surveys rather than objective empirical data. This is mainly because of the difficulty in obtaining data such as cultural differences, communication strategy, and employee motivation which affect the integration process. To my knowledge, this is the first paper to use empirical methods to estimate some of the factors affecting the merger integration process.

Since innovation is an important topic in the marketing and strategy, many studies have looked at the effect of acquisition on innovation. The empirical evidence has been split. Initial research in the strategy literature find that acquisitions tend to hurt innovation (Ernst and Vitt 2000; Miller 1990). They argue this may be due to integration distractions, employee turnover, or lower R&D spending to finance the acquisition (Hitt et al, 1990; Hitt et al, 1991). Prabhu, Chandy and Ellis (2005),

however, find that acquisition can assist innovation under certain conditions. They find that acquisitions can improve an acquiring firm's innovation potential, especially when the acquiring firm has deep and broad knowledge in the relevant area to begin with. Based on their findings, I use depth, breadth and similarity of knowledge to measure the knowledge base of acquirers and targets. I not only use these measures to study the effect of acquisition on innovation as Prabhu et al. (2005) did, but also use these measures in my matching stage since firms may chose partners based on these variables.

Sorescu, Chandy and Prabhu (2007) approach this question from a different angle and find that firms with better product capital are better at selecting target with innovation potential and deploying the target's innovation potential to gain competitive advantage. They focus on identifying the type of firms which are better at selecting and deploying innovation potential in an acquisition, not on studying the factors that affect the choice of target, integration process, or innovation outcome as I do. Sorescu et al. (2007) provide support for my assumption that firms differ in their ability to find a good partner, and such difference will carry on to the integration process. However, this may be just one aspect of the story. There are other things such as management styles, distribution channels, corporate culture that can also affect the strategic fit between two firms, beyond product capital. This paper does not try to exhaust all potential factors that influence the matching and outcome of merger, but tries to measure and differentiate the effects of sorting and integration. This paper also goes beyond pharmaceutical industry, which is the testing ground of the two papers above, and includes firms in five broad high tech industries which have an above average interest in innovation.

Besides the above mentioned empirical studies, some papers have employed a combination of survey and empirical methods to study the effect of acquisition on

innovation. Using in-depth surveys, Cassiman et al. (2005) find positive effect on R&D activities and efficiency from acquisition between technical complementary partners, and detrimental effect on R&D level and efficiency between technical substitutive partners. They also found that non-rival firms before merger benefit more in R&D efficiency than rival firms. They find that when merged firms are technologically substitutive, key employees tend to leave more often, the R&D portfolio becomes more focused, the R&D horizon becomes shorter and internal funds available to R&D decrease. Because of their survey method, their variables are more comprehensive than those used in this paper, but lack support from empirical data since those are based on managers' replies to hypothetical situations.

2.4: MODEL

2.4.1 The Merger Game

The theoretical model in this paper is inspired by works of Angelov (2006) and Sorensen (2005, 2007). Angelov (2006) introduces firm merger as a roommate problem in the matching model literature, and Sorensen (2005) provides an empirical application of the college admission model in the same literature.

I specify firm merger as a roommate matching problem. Alternative models have been attempted for the merger and acquisition problem, such as Yu and Rao (2009) who use a multinomial logit model. In their model only the acquirer's choice is considered, and the target firm is assumed to accept any request of merger that the acquiring firm makes. Such set up works when there is no other contender for the same target, and the offer made by the acquirer is reasonable. When the target faces several bidders and can only choose one acquirer, the multinomial logit model cannot explain well. In comparison this paper uses a matching game, which depends on the decisions of both sides of the merger deal.

The main stream matching models involve two-sided matching, a typical example of which is the marriage model. Marriage model studies the marriage decision of a group of men and women, according to their preference rankings. However, two sided matching is not suitable for analyzing firm mergers, because merger participants cannot always be naturally divided into two subgroups beforehand. Instead, the decision for a firm to be acquirer or target is endogenous to the game²⁴ (Angelov 2009).

The roommate game is well-studied in the game-theoretic literature. It is considered a subset of matching models. An early account of the roommate model can be found in Gale and Shapley (1962), in which an even number, say k , of persons wish to be divided up into pairs of roommates to share $k/2$ rooms. Each person ranks the remaining people in descending order, beginning with the person most preferred to share room with. A set of pairings (also called a matching) is considered stable if there are no two persons, currently not sharing room, who prefer each other to their actual roommates. In contrast to the two-sided matching games, roommate games do not always have stable matching.

While I adapt the frameworks of Angelov and Sorensen, my model has features that differentiate it from their models. As compared to Angelov (2006), my model is a true empirical model with real data, whereas his model is a theoretical one supplemented with some simulation results. Moreover, I generalize his model by assuming error terms to have normal distribution rather than extreme value

²⁴ For example, firm A might be considering to acquire firm B, but if firm C approaches firm A with an acquisition proposal, then the owners of A might choose to sell their shares to C, thus ending up being a target. For example Wyeth had been acquiring many drug companies until 2008, but was acquired by Pfizer in 2009. Another possibility is that A attempts to acquire B, but B attempts to acquire C to avoid being acquired by A, as was the case in the Arcelor- Mittal Steel takeover battle (see prior footnote).

distribution, thus being able to accommodate any number of game participants whereas his model is difficult to solve for more than three participants.

Likewise, this paper has several important differences from Sorensen (2005, 2007). First, the methodological and substantive issues answered in this paper are different. Sorensen (2007) corrects for matching induced endogeneity to identify the true influence of venture capitalist (VC) experience on IPO outcomes of startup firms. This paper not only corrects for matching induced endogeneity in estimating the drivers of merger outcome, but also identifies the drivers of integration process. Second, the matching games employed in these two studies are different. Sorensen uses a two-sided college admission model, while this paper, for reasons mentioned above, uses a one-sided roommate model. Third, due to differences in game set up and preference structures, the sources of endogeneity in the two papers are quite different. In Sorensen's case the source of endogeneity is the unobservable firm ability (by econometricians) which matches with experience of venture capitalists. In my essay the source of endogeneity is the unobservable features of the firms involved in merger (by econometrician) which match with each other.

2.4.1.1 Game Set-up:

There is a set of firms, denoted by $N = \{1, 2, \dots, i, \dots, n\} (n \geq 3)$. Each firm has a preference towards merging with the remaining $n-1$ firms, or stay on its own. Firm i 's preference ordering can be denoted by W_i which might take the form of, for example

$$W_i = \{2, 1, i, 6, \dots, n\} \tag{2-1}$$

This expression implies that firm i 's first choice is to merge with firm 2. If that is impossible, its second choice is to merge with firm 1, and if that also is unattainable, the firm prefers to continue operating on its own. I use $k \succ_i m$ to denote that i strictly

prefers merging with k to merging with m . These preferences are assumed to be complete, transitive, and strict²⁵.

I assume that no firm can be forced into a merger, thereby excluding the possibility of hostile takeovers. This assumption implies that the only part of the preference that matters in the above example is $W_i = \{2,1,i\}$, because none of the firms in $\{6, \dots, n\}$ is acceptable to i . The collected preference orderings of all firms are called the preference profile and denoted by $W = \{W_1, W_2, \dots, W_n\}$.

At the onset of the game, all n firms operate on their own, and their preference orderings are known. Any two firms i and j (or one firm if $i=j$), can potentially form a merger ij ($0 \leq i, j \leq n$). The set of potential matches is denoted by M ($ij \in M$), which can be considered as the upper half of an $n \times n$ matrix (with $1, \dots, n$ arranged along both dimensions) including cells along the diagonal. There are a total of $n(n+1)/2$ unique cells in M . The preferences of firms are assumed to be “aligned”, which means that there exist distinct values $V_{i,j}$ for preferences \succ_i and \succ_j for all $ij \in M$ such that $i' \succ_j i \Leftrightarrow V_{i',j} > V_{i,j}$ and $j' \succ_i j \Leftrightarrow V_{i,j'} > V_{i,j}$. Here, $V_{i,j}$ can be interpreted as the synergy that the two parties expect to realize beyond the value they will get by operating separately.

The model assumes that each merger participant will receive one-half of the synergies, which can take the form of expected net present value (NPV) (Ross, Westerfield and Jaffe 2006) at the time of merger announcement. This assumption is not as outrageous as it appears at a first glance. Most mergers are conducted with the mutual consent of the two firms. If the synergy is not fairly split, the party with the smaller share can choose another firm or stay alone. Also, the split need not be

²⁵ A totally ordered set is said to be **complete** if every nonempty subset that has an upper bound, has a least upper bound. For example, the set of real numbers \mathbf{R} is complete but the set of rational numbers \mathbf{Q} is not. Transitivity means if $a \leq b$ and $b \leq c$ then $a \leq c$. $<$ and $>$ indicate strictness and \leq and \geq are not.

proportional to the participant's size or profitability, because what is at stake is not the total value or control power of the joint firm, but the synergy created through the joint activities of the two firms. After the merger takes place, the acquiring firm managers will most likely gain control over the new firm and receive cash flow from the new firm, but target stockholders will get compensated through the premium acquirer pays at the time of acquisition.

The equilibrium for matching models is defined by a **stable matching** where all matches are individually acceptable (i.e., none of the matched firms prefers to be self-matched rather than its current matching), and in addition, no pair of firms prefer to be matched with each other rather than with their prevailing partner. The existence and uniqueness of the roommate game is proved in Roommate Game using a top-down sorting algorithm similar to the one in Sorensen (2005), which in turn is a simplification of the Deferred Acceptance Algorithm (Gale and Shapley 1962; Roth and Sotomayor 1990).

The unique equilibrium μ for the roommate game is characterized by

- (i) for all $ij \notin \mu$, it holds that $V_{i,j} < \max[V_{\mu(j),j}, V_{i,\mu(i)}]$;
- (ii) for all $ij \in \mu$ it holds that $V_{i,j} > \max[\max_{i' \in S(j)} V_{i',j'}, \max_{j' \in S(i)} V_{i,j'}]$

where $S(i)$ and $S(j)$ are feasible deviations of i and j . For i , $S(i)$ consists of all the firms that are willing to abandon their current match for i and operating alone:

$S(i) = \{j \in J \mid V_{i,j} > V_{\mu(j),j}\} \cup \{i\}$. The expression for $S(j)$ is similar. More details on these results and the proof of existence and uniqueness of the game equilibrium can be found in Roommate Game.

2.4.2 Roommate Game

2.4.2.1 Main Assumptions:

The model imposes restrictions on firms' preferences. Each potential match has a valuation, which can be interpreted as the synergy that two parties can obtain

beyond what they will get by operating separately. It can take the form of expected net present value (NPV) at the time of merger announcement. Due to reasons mentioned in the main body of the paper, the model assumes that each merger participant will receive half of the valuation

Definition 1 (Matching): A matching μ is a subset of M . It implies that each firm is either self-matched (i.e., continues to operate on its own), or is matched to one merge partner. A **stable matching** is one where all matches are individually acceptable (i.e., none of the matched firms prefers to be self-matched rather than its current matching), and in addition, no pair of firms prefer to be matched to each other rather than according to the prevailing matching.

Let the firm that merge with firm i be denoted by $\mu(j) \equiv \{i \in N \mid ij \in \mu\}$. With this notation $ij \in \mu$ is equivalent to $j \in \mu(i)$ which is again equivalent to $i \in \mu(j)$.

These notations will be useful in later proofs.

Definition 2 (Blocking): A match μ is blocked by a pair of firms $ij \in M$, if i and j both prefer each other to the firms they are matched to in μ . This is valid also for $i=j$, i.e., an individual firm i can block μ if it does not accept its current merging partner.

It has been shown by Gale and Shapley (1962) that a stable matching does not always exist. Irving (1985) designed an algorithm to determine whether there exists a stable matching, and if so, finds such a matching. Later, Tan (1991) and Chung (2000) find the conditions for strong and weak preferences under which stable matching(s) do exist. However, these conditions are too complicated to use in empirical estimation, and they do not guarantee uniqueness of the stable matching. Therefore, I turn to the empirical two-sided matching literature and adopt the preference assumptions in Sorensen (2005), which is designed for college admission models and applies to roommate model quite well.

Definition 3 (Aligned Preference): The preferences \succ_i and \succ_j are aligned when there exist distinct values $V_{i,j}$ for all $ij \in M$ such that $i' \succ_j i \Leftrightarrow V_{i',j} > V_{i,j}$ and $j' \succ_i j \Leftrightarrow V_{i,j'} > V_{i,j}$.

Alignment implies that each match has a value $V_{i,j}$. This value is called the valuation of the match. When $i=j$, $V_{i,i}$ would be the valuation of firm i operating independently. Matches with higher valuations are more attractive for firms, and the valuations provide an ordinal representation of their preferences. Alignment imposes a restriction on the preferences, because the same valuations represent the preferences for both sides of the merger. It is often natural to interpret the valuations as the monetary value generated by the match²⁶. However, the valuations implied by aligned preferences are ordinal. A positive monotone transformation of the valuations will leave the preferences unchanged.

2.4.2.2 The Top-Down Sorting Algorithm

This top-down sorting algorithm is used to determine the equilibrium matching in the merger game defined above. It is also adapted from Sorensen (2005). I will first describe the algorithm, and then prove that the matching generated through this algorithm is a stable and unique matching to the game. The intuition of the algorithm is the following. I start with the match with the highest valuation, and determine which matches became infeasible and which matches are still feasible. Then I locate the remaining feasible match with the highest valuation, and form this match, and continue in this fashion until there are no more feasible matches left.

The top-down sorting algorithm proceeds as follows.

²⁶ In this case, aligned preferences imply that the monetary value is assumed to be nontransferable between the firms. If the value were transferable, a firm could prefer a match with a lower valuation, if the match came with a sufficient compensating transfer. Alternatively, an agent could prefer a match with a lower valuation, if the agent received a larger fraction of the surplus from this match. Both of these cases are ruled out by the assumption of alignment. According to this assumption, firms always prefer matches with higher valuations, and there can be no compensating transfers. A model with transfers can be future extensions of this paper.

Start I use t to denote the iteration number. The current iteration is iteration 1, $t=1$. The set of feasible matches is $M^1 = M$. The set of previously formed matches is the empty set, $\mu^0 = \phi$.

Step 1 Let $i^t j^t$ be the match with the highest valuation among the feasible matches. This match is determined as $i^t j^t = \arg \max_{ij \in M^t} V_{i,j}$, and this match is unique by the assumption that $V_{i,j}$ values are all distinct.

Step 2 Append this match to the set of formed matches, $\mu^t = \mu^{t-1} \cup i^t j^t$, and let the valuation of the iteration be given by the valuation of this match, $v^t = V_{i^t, j^t}$.

Step 3 The set of matches that become infeasible as a result of the match $i^t j^t$ is R^t . There are two mutually exclusive cases:

Case 3.1 If $i^t = j^t$, then firm i^t prefers to remain unmatched to entering any of the remaining feasible mergers, and $R^t = M^t \cap \{ij \mid i = i^t\}$.

Case 3.2 If $i^t \neq j^t$, then the matches that are no longer feasible are given by $R^t = M^t \cap \{ij \mid i = i^t \text{ or } j = j^t\}$.

Step 4 The feasible matches in the next iteration are given by $M^{t+1} = M^{tR^t}$.

Step 5 If $M^{t+1} \neq \phi$, then reiterate from step 1.

Let $\tilde{\mu} = \mu^t$ denote the final matching when the algorithm ends. Since the maximization in step 1 is over a strictly decreasing sequence of sets, v^t is a strictly decreasing sequence.

2.4.2.3 Stability and Uniqueness of the Matching formed by Top-Down Sorting Algorithm

I present and prove here that the matching formed as above is a stable and unique matching.

Theorem 1 $\tilde{\mu}$ is a stable matching.

Proof. Assume for contradiction that $i'j'$ is a blocking pair, and thus is a pair that is not matched in $\tilde{\mu}$. Let t' be the first iteration in which firm j' or firm i' is matched

with their corresponding partner in μ' . In this iteration $i'j'$ must also be in the set of feasible matches, i.e. $i'j' \in M'$. Since the valuation of the iteration is decreasing, this implies that $V_{i',j''} > V_{i',j'}$ for all $j'' \in \tilde{\mu}(i')$, or $V_{i'',j'} > V_{i',j'}$ for all $i'' \in \tilde{\mu}(j')$. But this contradicts the assumption that $i'j'$ is a blocking pair. This shows that $\tilde{\mu}$ contains no blocking pairs. Assuming that either i' or j' is a blocking firm leads to contradictions by similar arguments. This shows that $\tilde{\mu}$ is a stable matching.

Theorem 2 The equilibrium is unique.

Proof. Let μ' be a matching that differs from $\tilde{\mu}$, and $\tilde{\mu}$ thus contains a match (including a self-match) which is not contained in μ' . In other words, there exists $ij \in \tilde{\mu}$ such that $ij \notin \mu'$. Consider the first iteration where the Top-Down Sorting Algorithm forms a match that is not contained in μ' . Let this iteration be t' , and let this match be denoted $i'j'$. First, assume that $i' \neq j'$, and let two of the firms that j' and i' match with in μ' be given by $i'' = \mu'(j')$ and $j'' = \mu'(i')$. Since t' is the first iteration where the algorithm forms a match that is not formed in μ' , the matches $i'j''$ and $i''j'$ must also have been feasible in this iteration. This implies that $V_{i',j''} > V_{i',j'}$ and $V_{i'',j'} > V_{i',j'}$, and thus $i'j'$ form a blocking pair for μ' . Second, when $i' = j'$, it follows by a similar argument that either i' or j' is a blocking firm for μ' . In either case, μ' is not stable. Therefore the equilibrium is unique.

2.4.2.4 Equilibrium Characterization

With aligned preferences, the equilibrium condition can be stated as a set of inequalities.

Theorem 3 The matching μ is stable *if and only if* for all $ij \notin \mu$ it holds that

$$V_{i,j} < \max[V_{\mu(j),j'}, V_{i,\mu(i)}].$$

Proof. The proof is a direct consequence of the definition of stable matching. To show the *if* direction, assume for contradiction that $ij \notin \mu$ is a blocking pair for μ . The definition of a blocking pair states that $i \succ_j \mu(j)$ and $j \succ_i \mu(i)$. The first

condition implies that $V_{i,j} > V_{\mu(j),j}$, and the second condition implies that $V_{i,j} > V_{i,\mu(i)}$. Together this implies that $V_{i,j} > \max[V_{\mu(j),j}, V_{i,\mu(i)}]$, which contradicts the assumption in the theorem. Assuming that i or j is a blocking firm leads to a contradiction by an analogous argument. For the *only if* direction, assume that μ is a stable matching, and choose a pair $ij \notin \mu$. Since, by assumption of stability, this is neither a blocking pair nor a blocking individual firm, it must be that either $\mu(j) \succ_j i$ or $\mu(i) \succ_i j$. In the first case, $V_{\mu(j),j} > V_{i,j}$, and in the second case, $V_{i,\mu(i)} > V_{i,j}$.

This theorem imposes upper bounds on the valuations of the matches that are not formed in the stable matching μ . A matching is stable when deviating is unattractive, and since the matches that are not formed represent the potential deviations, this condition naturally leads to upper bounds on the valuations of these matches. The bounds are increasing functions of the valuations of the matches that are formed in μ . It is possible to invert the inequalities and express them as lower bounds on the valuations of the matches in μ . To express the inequalities in this way, it is necessary to explicitly consider the sets of feasible deviations for each firm. For firm j the feasible deviations are the firms that prefer this firm to their current merger partners (together with the deviation to become self-matched). This set is given by

$$S(j) = \{i \in N \mid V_{i,j} > V_{i,\mu(i)}\} \quad (2-2)$$

Similarly, firm i 's set of feasible deviations contain firms that prefer this firm to their current match

$$S(i) = \{j \in N \mid V_{i,j} > V_{\mu(j),j}\} \quad (2-3)$$

Theorem 4 The matching μ is a stable matching *if and only if* for all $ij \in \mu$ it holds that $V_{i,j} > \max\{\max_{i' \in S(j)} V_{i',j}, \max_{j' \in S(i)} V_{i,j'}\}$.

Proof. Again the proof is a direct consequence of the definition of stable matching.

For the *only if* direction, let μ be a stable match, and let ij be a given match in μ .

Since μ is a stable match neither firm j nor firm i can benefit from deviating. For firm

j , this implies that $V_{i',j} < V_{i,j}$ for all $i' \in S(j)$. For firm i , it implies that $V_{i,j'} < V_{i,j}$ for all $j' \in S(i)$. Together this implies that inequality in the theorem. For the if direction, assume that the valuations satisfy the inequalities in the theorem. Let ij be a given match in μ , and it follows directly from the inequalities in the theorem that neither i nor j can be a blocking firm or part of a blocking pair.

The above results show that in equilibrium $\bar{V}_{i,j}$ and $\underline{V}_{i,j}$ provide upper and lower bounds for the valuations, where

$$\bar{V}_{i,j} = \max[V_{\mu(j),j}, V_{i,\mu(i)}] \quad (2-4)$$

$$\underline{V}_{i,j} = \max[\max_{i' \in S(j)} V_{i',j}, \max_{j' \in S(i)} V_{i,j'}] \quad (2-5)$$

The characterization results can now be stated as

$$\mu \text{ is a stable matching} \Leftrightarrow V_{ij} < \bar{V}_{ij} \text{ for all } ij \notin \mu \Leftrightarrow V_{ij} > \underline{V}_{ij} \text{ for all } ij \in \mu \quad (2-6)$$

2.4.3 Structural Empirical Model

Based on the general roommate game setup, I further specify the expected values of the matching and outcome of the merger in empirical model. The structural empirical model comprises two parts. The first part of the model is the matching function given by

$$V_{ij} = W_{ij}'\alpha + \eta_{ij} \quad (2-7)$$

where V_{ij} is the valuation of each potential match $ij \in M$, $W_{ij} \in R^k$ is a vector of observed characteristics for firm i and firm j , and $\alpha \in R^k$ contains the parameters to be estimated. The error term η_{ij} contains factors affecting merger fit that are unobserved in the data.

The specification of the matching function reflects the merger synergies that the two firms expect to gain from the deal. These synergies are unobserved in the data, and in the empirical model these are latent variables. These synergies represent the

evaluations on net present value (NPV) that firms have towards the potential joint entity with the partner firm at the time of merger.

Let the set of valuations for which μ is the equilibrium be given by Γ_μ . Substituting the valuation equation into the equilibrium condition gives the equilibrium condition

$$\mu \text{ is stable} \Leftrightarrow \eta \in \Gamma_\mu - W\alpha \quad (2-8)$$

where $\eta \in R^{|M|}$ are the error terms and $W \in R^{|M| \times k}$ are the observed characteristics for the entire market. The term $W\alpha \in R^{|M|}$ denotes matrix multiplication of W_{ij} with α for each potential match (so $W\alpha = (W'_{ij}\alpha, ij \in M)$) Let $1[\cdot]$ be the indicator function. Then the likelihood function of the matching model is given by

$$L(\mu; \alpha) = \Pr(\eta \in \Gamma_\mu - W\alpha) = \int 1[\eta \in \Gamma_\mu - W\alpha] dF(\eta) \quad (2-9)$$

When several independent matching markets are observed, the likelihood function is the product over these markets, and, at least in principle, α can be estimated directly by maximizing this function.

The empirical matching model is a discrete choice model, and its parameters are only identified up to scale and level. This is natural, since the valuations represent preferences and these are unaffected by a change in the level or scale of the valuations. This means that the constant term (and other characteristics that are constant within each market, such as industry specific dummies) is excluded from W , since the corresponding coefficient is unidentified. This normalizes the level of the parameters. The scale is normalized by setting the variance of the error term equal to one.

The second part of the structural model is the outcome equation. For each $ij \in M$, let

$$Y_{ij} = X'_{ij}\beta + \varepsilon_{ij}, \quad (2-10)$$

where X_{ij} contains observed characteristics and β contains the parameters to be estimated. The error term contains factors that are unobserved in the data. Some of

these factors may be observed by the firms involved at the time of the merger decision. Y_{ij} does not have to be scalar, but can be a vector, which represents different measurements of merger performance such as changes in innovational potential, sales, profit, R&D spending, etc. The vector regression can be estimated as system of equations. For simplicity, I focus on the singular Y_{ij} case, and will extend the model to multiple regression equations in the future.

2.4.3.1 Error Distribution

The error terms are assumed to be independent of X and W , and this assumption identifies the parameters of the model. Since the outcome equation is defined for all $ij \in M$, the estimated parameters predict the outcomes of all potential matches, not just the observed ones. The estimated coefficient on the outcome function reflects the influence of the two firms' attributes on the merger outcome, after controlling for the unobserved sorting in the market.

The coefficients in the matching equation capture preferences over matches. When the coefficient on the firms' attributes (and their interactions) are significant, it means the firms participating in the merger use these attributes as criteria to select their partners. If the coefficients are close to zero and insignificant, then either the matching is random or it depends on characteristics not included in the matching equation.

For tractability, the joint distribution of $(\varepsilon_{ij}, \eta_{ij})$ is assumed to be independent for different matches and to follow the bivariate normal distribution

$$\begin{pmatrix} \varepsilon_{ij} \\ \eta_{ij} \end{pmatrix} \sim N\left(0, \begin{bmatrix} \sigma^2 + \delta^2 & \delta \\ \delta & 1 \end{bmatrix}\right) \quad (2-11)$$

With a normal prior distribution (conjugate prior), the posterior distributions are also normal or truncated normal. However, normality is not essential for the estimation or identification of the model, and it could be relaxed. The variances of the

two error terms normalize the scales of the two equations. The variance of η_{ij} is set to one, and the variance of ε_{ij} is set to $1 + \delta^2$. This normalization is convenient for the estimation and is without loss of generality.

The covariance between the error terms captures unobserved factors that affect both the outcome and the valuation of a match. For example, a target company may have pipeline projects that fit the acquiring firm's strategic goal. This is unobserved in the data, but it is partly observed by the acquirer before finalizing the deal and is important for the outcome. To the extent that an unobserved variable affects both the expected synergies at time of merger as well as the realization of actual synergies after merger, it enters the error terms in both the outcome and the matching equations, inducing a positive correlation between these two error terms. The covariance therefore reflects factors that are unobserved in the data, but affect the outcome and are taken into account in the initial valuation. This captures sorting over characteristics that are unobserved in the data.

If I assume that the factors used by managers for matching are the same as the ones that affect outcome (except the factors influencing the integration process, which are usually not quantifiable), I will have a same set of X and W . By comparing the parameter estimates for the matching and outcome functions, I can tell whether the managers' underestimated integration problems in the merger. This is because the difference between expected synergies and average realized synergies must be due to factors that were unanticipated by managers but could have been anticipated if they had complete information.

2.4.3.2 Interaction, Estimation and Identification

The matching model allows merger decisions to interact. When an acquirer merges with a target, other acquirers cannot merge with this same target and their

merger decisions interact. Interaction leads to sorting²⁷ in the market, and interaction and sorting are two fundamental properties of the model that have implications for both the estimation and the identification.

For the estimation, interaction means that each agent's merger decision cannot be analyzed in isolation. Unlike, for example, the Probit model, the likelihood function does not factor into a product over the likelihood of each agent's action (matching decision). To evaluate the likelihood function, all error terms must be integrated simultaneously. The dimensionality of this integral runs into thousands, and currently it is not possible to evaluate such high-dimensional integrals with the speed and precision required for Maximum Likelihood estimation (Judd 1998). However, Bayesian estimation using Markov Chain Monte Carlo (MCMC) circumvents this integration problem, and the model is estimated from iterated simulations of the posterior distribution. Berger (1993), Tanner (1998), and Robert and Casella (2004) are introductions to this estimation method.

While interaction and sorting complicate the estimation, they also provide the solution to the endogeneity problem. As illustrated in the initial example, the endogeneity problem arises from unobserved company characteristics, which are captured by the error term in the matching model. Because of sorting and interaction, the presence of other agents (and their characteristics more generally) affects merger decisions, and leads firms with differing strategic goals to find partners with different unobserved characteristics to reinforce their goals. Implicitly, this facilitates the direct comparison of different markets and it identifies the parameters of the model. Thus the identifying assumption is that the presence and characteristics of the agents in each market are exogenously given and independent of the error terms of the model.

²⁷ Sorting here refers to the process that firms on the market find each other according to their own merger preferences and finally the entire market reaches equilibrium when no firm want to or is able to deviate.

2.4.3.3 Estimation Method

The model is estimated using Bayesian estimation based on MCMC simulation, which has attractive properties for estimating discrete choice models (Geweke, Keane, and Runkle 1994). Albert and Chib (1993) and Tanner and Wong (1987) show that treating latent variables as parameters significantly simplifies simulation of the resulting augmented posterior distribution, and the MCMC procedure known as Gibbs sampling (Gelfand and Smith 1990, Geweke 1999) can simulate this distribution. The procedure is iterative. Each iteration produces a draw from a Markov Chain, and under weak regularity conditions that are satisfied here (Roberts and Smith 1994), the simulated distribution converges to the augmented posterior distribution. The Markov chain is generated by drawing each individual dimension of the joint target distribution conditional on the draws of the other dimensions, and the simulated univariate conditional distributions are derived in next paragraph. The estimation method used here adapts the estimation procedure for college admissions model used by Sorensen (2007) to estimate my roommate matching model.

For notation, let the markets be indexed by $m=1, \dots, N$. Let $V_m \equiv \{V_{ij}, ij \in M_m\}$ and $Y_m \equiv \{Y_{ij}, ij \in \mu_m\}$ be the latent valuation and outcome variables in market m , and let V and Y contain these variables in all markets. Let Y_{-ij} contain all outcome variables except Y_{ij} , and define V_{-ij} similarly. Let W_{ij} denote the vector of exogenous variables in the valuation equation for the match between firm i and firm j . Let $W_m \equiv \{W_{ij}, ij \in M_m\}$ contain these variables in all markets. Let $X_m \equiv \{X_{ij}, ij \in M_m\}$ be the exogenous variables in the outcome equation for all markets. Similarly, define the variables containing the matching, μ_{ij} , μ_m , and μ (here, μ_{ij} is a binary variable that equals one when the match is formed, and μ_m is a subset of M_m). Let

$\theta \equiv (\alpha, \beta, \delta)$ contain the parameters of the model. Finally, the densities defined by the model are denoted ϕ and the densities derived for the simulation are denoted π .

The prior distribution is a normal distribution. Let the prior density be denoted $\phi_0(\theta)$. This density is given by

$$\phi_0(\theta) = C \times \exp\left(-0.5(\theta - \theta_0)' \Sigma_\theta^{-1}(\theta - \theta_0)\right) \quad (2-12)$$

where C is a generic normalizing constant (here and below) that ensures densities integrate to one. The matrix Σ_θ is the covariance matrix of the prior distribution, and is specified as 10 times the identity matrix. Further increases in the prior variance leave estimated parameters largely unchanged. Corresponding to the parameters, the covariance matrix is decomposed into Σ_α , Σ_β , and Σ_δ .

The error term in the outcome equation can be decomposed into orthogonal terms as $\varepsilon_{ij} = \eta_{ij}\delta + \xi_{ij}$, where the joint distribution of ξ_{ij} and η_{ij} is

$$\begin{pmatrix} \xi_{ij} \\ \eta_{ij} \end{pmatrix} \sim N\left(0, \begin{bmatrix} \sigma^2 & 0 \\ 0 & 1 \end{bmatrix}\right) \quad (2-13)$$

This is without loss of generality, as the joint distribution of $(\varepsilon_{ij}, \eta_{ij})$ is still given by equation (11). Let $\phi_m(V_m, Y_m | \theta, X_m, W_m)$ be the density of the latent variables defined by the matching and outcome equations. The matching equation implies $\eta_{ij} = V_{ij}' - W_{ij}'\alpha$ and the density of the latent variables in market m is

$$\begin{aligned} \phi_m(V_m, Y_m | \theta, X_m, W_m) &= C \times \prod_{ij \in M_m} \exp(-0.5(V_{ij} - W_{ij}'\alpha)^2) \times \\ &\quad \prod_{ij \in \mu_{ij_m}} \exp(-0.5(Y_{ij} - X_{ij}'\beta - (V_{ij} - W_{ij}'\alpha)\delta)^2) \end{aligned} \quad (2-14)$$

The augmented posterior density is proportional to the product of the prior density, some appropriate indicator functions, and the density of the latent variables given above. It is given by

$$\phi(V, Y, \theta | \mu, X, W) = C \times \phi_0(\theta) \times \mathbb{I}[\delta \geq 0] \times \prod_{m=1}^M (\mathbb{I}[V_m \in \Gamma_{\mu_m}] \times \phi_m(V_m, Y_m | \theta, X_m, W_m)), \quad (2-15)$$

The densities derived below are all proportional to selected factors in the density in equation (2-15).

A. Conditional Distributions of Outcome Variables

The conditional augmented posterior density for each outcome variable is proportional to the term this variable enters in ϕ in equation (2-15), the corresponding term in ϕ_m from equation (14). The density of the conditional distribution of each outcome variable is

$$\pi(Y_{ij} | V_{-ij}, Y_{-ij}, \theta, \mu, W, X) = C \times \exp(-0.5(Y_{ij} - X'_{ij}\beta - (V_{ij} - W'_{ij}\alpha)\delta)^2), \quad (2-16)$$

This is the normal distribution $N(X'_{ij}\beta + (V_{ij} - W'_{ij}\alpha)\delta, 1)$.

B. Conditional Distributions of Matching Variables

The conditional augmented posterior distribution of V_{ij} depends on whether firm i and firm j are matched or not. When $ij \notin \mu_m$, the density is simply

$$\pi(V_{ij} | V_{-ij}, Y, \theta, \mu, X, W) = C \times \mathbb{1}[V_{ij} \leq \bar{V}_{ij}] \times \exp(-0.5(V_{ij} - W'_{ij}\alpha)^2). \quad (2-17)$$

When $ij \in \mu_m$, the outcome of the match is observed. Correlation between the error terms means that the outcome contains additional information about the matching, and the conditional density is given by

$$\pi(V_{ij} | V_{-ij}, Y_{ij}, \theta, \mu, X, W) = C \times \mathbb{1}[V_{ij} \geq \underline{V}_{ij}] \times \exp\left(-0.5\left(V_{ij} - W'_{ij}\alpha - \frac{(Y_{ij} - X'_{ij}\beta)\delta}{1 + \delta^2}\right)^2 \times (1 + \delta^2)\right) \quad (2-18)$$

Both the distributions shown in (2-17) and (2-18) are truncated normal distributions. The first is $N(W'_{ij}\alpha, 1)$ truncated from above at \bar{V}_{ij} . The second is $N(W'_{ij}\alpha + (Y_{ij} - X'_{ij}\beta)\delta / (1 + \delta^2), 1 / (1 + \delta^2))$ truncated from below at \underline{V}_{ij} . The expressions for \bar{V}_{ij} and \underline{V}_{ij} are given in equations (2-4) and (2-5) on page 89.

C. Conditional Distributions of Parameters

The conditional distributions of the parameters are normal distributions. The distributions of α and β are not truncated. The distribution of δ is truncated from below at zero to normalize the sign of the matching equation. Each parameter enters

all the terms in ϕ , and the derivation of the distributions requires “completing the square” in a product of normal densities. To illustrate, let γ be a random vector with density

$$\pi(\gamma) = C_1 \times \exp(-0.5(\gamma' M_\gamma \gamma + 2\gamma' N_\gamma + C_2)). \quad (2-19)$$

Here, M_γ is a corresponding matrix and N_γ is a corresponding vector (naturally, C_1 and C_2 could be combined into the single normalizing constant $C = C_1 \times \exp(-0.5C_2)$). Completing the square in this expression shows that the distribution of γ is the normal distribution $N(-M_\gamma^{-1}N_\gamma, M_\gamma^{-1})$.

Collecting terms in ϕ involving α gives $\pi(\alpha | V, Y, \beta, \delta, \mu, X, W)$. This distribution is determined by M_α and N_α as follows:

$$M_\alpha = \Sigma_\alpha^{-1} + \sum_{m=1}^N \left[\sum_{ij \in M_m} W_{ij} W_{ij}' + \sum_{ij \in \mu_m} \delta^2 W_{ij} W_{ij}' \right] \quad (2-20)$$

$$N_\alpha = -\Sigma_\alpha^{-1} \bar{\alpha} + \sum_{m=1}^N \left[\sum_{ij \in M_m} -W_{ij} V_{ij} + \sum_{ij \in \mu_m} \delta W_{ij} (Y_{ij} - X_{ij}' \beta - V_{ij} \delta) \right] \quad (2-21)$$

Similarly, collecting terms in ϕ involving β gives

$$M_\beta = \Sigma_\beta^{-1} + \sum_{m=1}^N \sum_{ij \in \mu_m} X_{ij} X_{ij}' \quad (2-22)$$

$$N_\beta = -\Sigma_\beta^{-1} \bar{\beta} + \sum_{m=1}^N \sum_{ij \in \mu_m} X_{ij} (Y_{ij} - V_{ij} \delta + W_{ij}' \alpha \delta) \quad (2-23)$$

Finally, for δ , collecting terms gives

$$M_\delta = \Sigma_\delta^{-1} + \sum_{m=1}^N \sum_{ij \in \mu_m} (V_{ij} - W_{ij} \alpha)^2 \quad (2-24)$$

$$N_\delta = -\Sigma_\delta^{-1} \bar{\delta} + \sum_{m=1}^N \sum_{ij \in \mu_m} X_{ij} (Y_{ij} - X_{ij}' \beta) (V_{ij} - W_{ij}' \alpha) \quad (2-25)$$

The conditional distribution of δ is $N(-N_\delta / M_\delta, 1 / M_\delta)$, truncated from below at zero.

2.5: SIMULATION RESULTS

In this section, I use simulation to demonstrate the efficacy of my estimation procedure in recovering parameters. The simulation is based on the following specification.

Matching function is assumed to be given by the balance model²⁸ design (Rao, Mahajan and Varaiya 1991):

$$S_{ij} = a \times (X_{1i} + X_{1j}) - b \times (X_{2i} - X_{2j})^2 + c \times (X_{3i} - X_{3j})^2 + \eta_{ij} \quad (2-26)$$

and the outcome equation is assumed to be given by

$$Y_{ij} = a' \times (X_{1i} + X_{1j}) - b' \times (X_{2i} - X_{2j})^2 + \delta \times \eta_{ij} + \varepsilon_{ij} \quad (2-27)$$

where I assume that

$$a = a' = 1, b = b' = -0.5, c = 0.5, \delta = 0.4 \quad (2-28)$$

$$X_{ij} \approx N(0, \sigma_{i,obs}), \varepsilon_{ij} \approx N(0, \sigma_{unobs}) \quad (2-29)$$

The results of the outcome estimation are compared against the following OLS estimation

$$Y_{ij} = \theta + \alpha \times (X_{1i} + X_{1j}) - \beta \times (X_{2i} - X_{2j})^2 + e_{ij} \quad (2-30)$$

For the case where $\sigma_{1,obs} = \sigma_{unobs} = 2$ and $\sigma_{2,obs} = 1$, the results of the joint estimation and the OLS are included in Table 2-2. As shown in the panel 3A of this table, the joint estimation recovers most of the parameters well, and the bias in parameter estimation is considerably reduced as compared to the OLS regression. The model does not fully recover the second parameter in the outcome equation (although it is less biased than the OLS). This is because the standard deviation of the outcome is

²⁸ The balance model postulates that in describing a decision-maker's preferences for subsets, essential attributes (attributes that have nonzero influence on preferences for subsets) can be grouped into two classes—nonbalancing and balancing. The nonbalancing attributes are those for which the decision-maker wishes to optimize the mean of the items in the subset for these attributes. In contrast to the nonbalancing attributes, the balancing attributes are those for which the decision-maker wishes to optimize the dispersion of the items in the subset for these attributes. The attributes with a lower preferred dispersion are called "equibalancing" and those with a higher preferred dispersion are called "counterbalancing."

high (4) as compared to the standard deviation of $(X_{2i} - X_{2j})^2$. Therefore the noise is too large to fully recover the true parameter. Moreover, the marginal log likelihood of the joint estimation is significantly higher as compared to that of OLS, and the Bayes factor $K \gg 100$, suggests that the joint model is decisively better than the linear regression model.

Figure 2-1 shows how the bias in estimation depends on the ratio of the standard deviation of X_1 and the unobserved variables. As the variance of unobserved variables increases, the bias in estimation increases. Nonetheless, in each case, the joint estimations perform better than OLS.

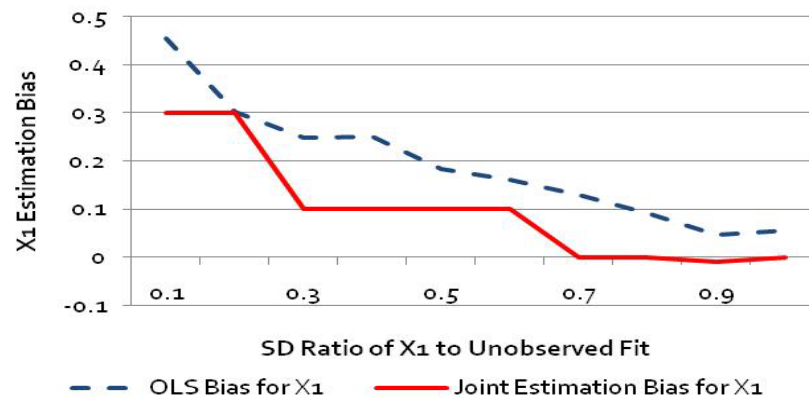


Figure 2-1: Estimation Bias as a Function of the Ratio of Standard Deviation of Observed and Unobserved Variables

The results in this section show that my estimation procedure for the structural model recovers the model parameters in the case where the observed variables explain a significant part of the variation in the matching function, thus eliminating matching induced bias and performing significantly better than OLS. On the other hand, when the observed variables explain a small part of the variation in the matching function, the model cannot eliminate the matching induced bias but performs significantly better than OLS.

2.6: EMPIRICAL SPECIFICATION

As discussed earlier, I estimate the following matching and outcome expressions:

$$V_{ij} = W_{ij}'\alpha + \eta_{ij} \quad (2-31)$$

$$Y_{ij} = X_{ij}'\beta + \varepsilon_{ij}, \quad (2-32)$$

subject to the following error correlations:

$$\begin{pmatrix} \varepsilon_{ij} \\ \eta_{ij} \end{pmatrix} \sim N\left(0, \begin{bmatrix} \sigma^2 + \delta^2 & \delta \\ \delta & 1 \end{bmatrix}\right)$$

If the managers have complete information and are fully rational, X_{ij} will be the same as W_{ij} , and β will be equal to α . This is because in such a case managers would have rational expectations and the realized synergies would be distributed evenly around their expectations of synergy. However, it is arguable whether managers have complete information given the uniqueness of each merger and the rarity and complexity of the merger event. There is sufficient anecdotal evidence that suggests managers do not fully anticipate integration problems, implying that expected synergies are biased on average as compared to the realized synergies. Since this is the first paper to attempt to empirically estimate the integration effect, I will not impose structure on α and β , but leave it to be recovered from the data. With the foundation laid by this paper, future research can choose to impose more structure into the relationship.

I do impose $W_{ij} = X_{ij}$ because there is no basis to decide which variables affect matching and which affect outcome. Since it is difficult to identify universal variables across five broad industries, I only use financial and knowledge variables as independent variables in these two equations. The model's design takes into account the possibility of missing variables in the matching model, since the effect of unobserved variable is carried over to the outcome model where the model adjusts the

bias introduced by these variables. The explanations of the dependent variable Y_{ij} and the independent variables in W_{ij} and X_{ij} are included in Table 2-3.

Table 2-2: Explanation of Dependent and Independent Variables in Matching and Outcome Equations

Dependent Variable	Explanation
change_in_new_patent_n	Log (new patents n year after merger - combined new patents 1 year prior to merger + 5)
change_in_sale_n	Log (sales in year n after merger / combined sales 1 year prior to merger)
change_in_roa_n	ROA in year n after merger - average ROA 1 year prior to merger
change_in_R&D_n	Log(R&D spending in year n after merger - combined R&D spending 1 year prior to merger)
Independent Variable	Explanation
nation_match	1 if the nation of the two firms match, 0 otherwise
industry_match	1 if the industry of the two firms match, 0 otherwise
Sum_logassets	Sum of the log of assets of the two firms 1 year prior to merger
Sum_roa	Average of the return on assets of the two firms 1 year prior to merger
Sum_book_leverage	Average of the book leverage of the two firms 1 year prior to merger
Diff_logassets	Absolute difference of the log assets of the two firms 1 year prior to merger
Diff_roa	Absolute difference of the return on assets of the two firms 1 year prior to merger
Diff_book_leverage	Absolute difference of the book leverage of the two firms 1 year prior to merger
breadth_of_knowledge	Number of patent groups where the combined firm has patents 1 year prior to merger
depth_of_knowledge	Total number of patents of the combined firm 1 year prior to merger / Breadth_of_knowledge
similarity_of_knowledge	Number of patent groups where both firms have patent 1 year prior to merger
square_similarity	Square of similarity_of_knowledge
square_depth	Square of depth_of_knowledge
square_breadth	Square of breadth_of_knowledge

2.6.1 Dependent Variables

The dependent variable V_{ij} in the matching equation is latent and need not be specified. For the outcome equation, I employ multiple measures of innovation output Y_{ij} . I look at the change in patents, sales, return on assets, and R&D spending in the first, second and third year after the merger as compared to the corresponding values in the year prior to merger. I employ these measures across multiple years because the horizon over which to measure merger performance is not clear. I employ multiple

variables in a given year because changes in innovation output resulting from a merger could get reflected in the number of issued patents, sales, profitability and R&D spending of the combined firm.

Patent data has been used by many studies as a measure of innovation output (Hall, 1990, 1999; Ravenscraft and Scherer, 1987; Lichtenberg, 1992; Hitt et al. 1991, 1996; Blonigen and Taylor, 2000). Several marketing studies on innovation also favor patent as a measure of innovation potential (Prabhu, Chandy and Ellis 2005; Chandy et al. 2006; Sorescu, Chandy and Prabhu, 2007).

Patent data has both significant strengths and weaknesses as measure of innovation output. First, patents are directly related to inventiveness: they are granted only for 'non-obvious' improvements or solutions with discernible utility (Walker, 1995). Second, they represent an externally validated measure of technological novelty (Griliches, 1990). Third, they confer property rights upon the assignee and therefore have economic significance (Kamien and Schwartz, 1982: 49; Scherer and Ross, 1990:621). Patents also correlate well with other measures of innovative output. Empirical studies find that patents are closely related to measures such as new products (Comanor and Scherer 1969), innovation and invention counts (Achilladelis, Schwarzkopf and Cines, 1987), and sales growth (Scherer, 1965). Expert ratings of corporate technological strength are also highly correlated with the number of patents held by corporations (Narin, Noma, and Perry, 1987). Furthermore, surveys of patent holders indicate that the rate of utilization of patents is reasonably high, with estimates indicating that between 41 percent and 55 percent of all patents granted are put to commercial use for at least a limited time (Griliches, 1990). Similarly, about 50 percent of all patents granted are still being renewed and a renewal fee is being paid 10 years after the patents had originally been applied for (Griliches, 1990;

Schankerman and Pakes, 1986). Given a non-negligible renewal fee, this indicates a significant usefulness for the majority of patents for a significant time period.

However, the use of patents as a measure of innovative output also has limitations. Some inventions are not patentable, others are not patented, and the inventions that are patented differ greatly in economic value (Cohen and Levin, 1989; Griliches, 1990; Trajtenberg, 1990). Research and the logic of appropriability indicate that the degree to which the first two of these factors is a problem varies significantly across industries (Cohen and Levin 1989; Levin et al., 1987). Limiting the study to a single industrial sector or a few closely related sectors minimizes such problems as the factors that affect patenting propensity are likely to be stable within such a context (Basberg, 1987; Cohen and Levin, 1989; Griliches, 1990).

To supplement the information provided by patents, I also use growth in sales and profitability to measure the economic benefit brought in by patents. Since patent is an early stage of innovation outcome, counting the number of patents cannot capture the different economic value of those patents. However, when patents get developed into products, they generate revenue which is reflected in sales and profitability. I also include R&D spending as one of the dependent variables to study the effect of merger on innovation input.

2.6.2 Independent Variables

The specification of independent variables W_{ij} and X_{ij} is partly inspired by the balance model used in the literature on target selection (Rao, Mahajan and Varaiya 1991; Yu and Rao 2009). In the balance model, the utility function comprises sums and squared differences of the features of acquirer and target. I include sum and absolute differences of acquirer and target total assets, return on assets, and book

leverage which are roughly²⁹ the same financial variables as those used by Rao et al. (1991). While Rao et al. (1991) also include non-financial data such as brand and distribution variables in this framework; I do not do so because such data is not readily available. Instead, as discussed below, I include knowledge data in the framework of Prabhu et al. (2005).

Amongst these financial variables, the relative size of the two firms (difference in log assets) has received the most attention in the literature. Kitching's (1967) early study indicated a strong positive relationship between the size of a target firm relative to an acquiring firm and organizational performance. Later interviews by Kitching (1974) with CEOs involved in acquisitions supported this finding. The executives suggested that prospects for success are improved if a target firm is larger (rather than smaller) relative to an acquiring firm. Other studies support these contentions. Waldman (1983) reported that the larger an acquiring firm relative to the size of a target, the more managerial diseconomies. Biggadike (1979) found that large-scale entries into new ventures resulted in better performance than small-scale entries. These results are inconsistent with the belief that it is desirable to enter a new area in a small way, learn, and expand (Lubatkin, 1983). In contrast, Kuehn (1975) suggested that acquiring a large firm requires more integration effort and, additionally, may strain the financial position of a purchaser. Newbould, Stray and Wilson (1976) found no relationship between relative size in acquisitions and return to shareholders. More recently, Kusewitt (1985) found significant negative relationships between relative size of acquirer to target and two performance measures, but some evidence that a

²⁹ Rao et al (1991) use sales whereas I use total assets because the former has extreme values which do not fit the distributional assumptions in my model. Moreover, my use of absolute differences is equivalent to their use of squared differences. Finally, they use market-to-book ratio and insider share ownership in the balance model, but I ignore these variables because these variables can be calculated only if the firm's stock trades in the market which is not the case for most firms in my sample.

peaked (quadratic) relationship exists. Kusewitt concluded that excessively small or large acquisitions should be avoided.

As for knowledge variables, Prabhu et al. (2005) find evidence that firms with high depth of knowledge produce more innovations from acquisitions than do firms with low depth of knowledge. Such a result is not significant for firms with high breadth of knowledge. Finally, they find that firms with moderate similarity of knowledge produce more innovations from acquisitions than do firms with very high or very low similarity of knowledge. However, their study only looks at depth, breadth and knowledge of acquiring firm rather than those of the combined firm. I extend their measures of depth, breadth and similarity of knowledge to include not only acquirer knowledge but also target knowledge. Moreover, to capture the non-linear (potentially non-monotonic) effects of acquirer and target knowledge, I include square terms of depth, breadth and similarity of knowledge. Breadth of knowledge for a pair of firms is measured as the number of patents groups in which the combined firm has patents. It is the union of acquirer's and target's breadth of knowledge. Henderson and Cockburn (1996) found evidences for both scale and scope economies in pharmaceutical companies' research productivity. Similarity of knowledge for a pair of firms is measured as the proportion of patent groups of the combined firm in which each firm has patents. It is the ratio of the intersection of the two firm's breadth of knowledge and the combined firm's breadth of knowledge. Depth of knowledge is measured as the average number of patents per patent group for each patent group in which the combined firm has a patent. It is the ratio of total number of patents of the combined firm and the breadth of knowledge of the combined firm.

Table 2-3: Industry Sub-classes

All Biotechnology	code	All Computer Equipment	code
In-Vivo Diagnostic Products	111	Mainframes & Super	211
In-Vitro Diagnostic Products	112	Workstations	212
Genetically Eng. Prod(Human)	113	Micro-Computers(PCs)	213
Genetically Eng. Prod(Animal)	114	Portable Computers	214
Vaccines/Specialty Drugs	115	Turnkey Systems	215
General Pharmaceuticals	116	CAD/CAM/CAE/Graphics	216
Over-The Counter Drugs	117	Other Computer Systems	219
Nuclear Medicines	118	Printers	221
Medical Chemicals	119	Disk Drives	222
Drug Delivery Sys(Not IV Sys)	120	CD Rom Drives	223
Blood Derivatives	121	Networking Systems	224
Research & Development Firm	122	Monitors/Terminals	225
Other Biotechnology	129	Scanning Devices	226
Medical Lasers	131	Modems	227
Medical Imaging Systems	132	Other Peripherals	229
Surgical Instruments/Equipment	133	Database	231
Lab Equipment	134	Operating Systems	232
Rehabilitation Equipment	135	Applications	233
Artificial Organs/Limbs	136	Application Software(Home)	234
Medical Monitoring Sytems	137	Desktop Publishing	235
General Med. Instruments/Supp.	138	Communication/Network	236
Healthcare Services	140	Utilities/File Mgmt Software	237
Semiconductors	311	Other Software(inq. Games)	239
Superconductors	312	Programming Services	241
Printed Circuit Boards	313	Computer Consulting	242
Process Control Systems	314	Data Processing Services	243
Precision/Measuring Test Equip	315	Other Computer Related	249
Search, Detection, Navigation	316	All Communications	
Other Electronics	319	Telecommunications	401
All Others		Telephone Interconnect	411
Robotics	511	Messaging Systems	412
Lasers(Excluding Medical)	512	Cellular Communications	413
Nuclear (Excluding Medical)	513	Satellite Communications	414
Propulsion Systems	514	Microwave Communications	415
Satellites (Non-Communications)	515	Alarm Systems	416
Advanced Materials	516	Facsimile Equipment	417
Defense Related	517	Data Commun(Exclude	418
Advanced Manufacturing	518	Other Telecommunications	419
Other	519	Internet Services & Software	420

One potential criticism of the specification of the expected synergy function is that it does not capture all possible motivations of M&A. Different deals may also have different motivations. Aggregating these deals together in one model mitigates the effect of individual motivation. However, there are obvious practical difficulties in controlling for all possible factors. Under my current construction, the uncontrolled variables will enter the error term. If the effect of the error term is overwhelming, the variables included will become insignificant. Any effects that are still significant in spite of the “noise” in the error term are probably more salient in reality.

I also control for cases where the two firms are from the same country, or belong to the same sub-industry group³⁰ (see Table 2-4). Cross-country businesses involve multiple accounting, tax, and business regulations, which may impose extra barrier for cross-border mergers. On the other hand, such mergers can also provide opportunity to enter a new market. Since firms in the same sub-industry group operate in closely related businesses, according to the strategic fit theory, they are more likely to find each other in line with their own strategic positioning. On the other hand, firms in too close markets may cause cannibalization and reduce room for learning (in case of technique oriented mergers). To sum, these two dummy variables may have either positive or negative effect and are important factors to control for.

The commonality of industry has received lot of attention in the literature. A number of studies look at performance differences associated with various forms of diversification (Channon 1973; Christensen and Montgomery, 1981; Dyas, 1972; Horovitz and Thietart, 1982; Pavan, 1972; Rumelt, 1974, 1982). Rumelt (1974, 1982) and Bettis (1981) provide research findings suggesting that firms that engaged in related diversification experience greater performance gains. Holzmann, Copeland and

³⁰ If the industry codes match at the two digits level, the two firms belong to the same general area but not the same niche market. In my analysis I use both refined classification matching and higher level matching..

Hayya (1975) also report significantly lower rates of return for unrelated diversification efforts. Rumelt (1982) clearly indicates a need for future research on the relationships among diversification type, industry and performance. He points out a need for further understanding of why firms diversify in an unrelated manner, and the management patterns associated with such diversification.

2.7: DATA

The data on merger and acquisition deals is collected from SDC Platinum. This database is comprehensive and has been used by a number of M&A researchers in marketing, such as Sorescu, Chandy and Prabhu (2007), Swaminathan, Murshed and Hulland (2008) and Sorensen (2007). I obtain all the M&A deals from January 1992 to December 2008 in high tech industries, which fall into five large categories, as shown in Table 2-4. I impose the requirement that both firms participating in the merger belong to a high tech industry.

In order to make the sample representative, I did not impose the requirement that all the firms be public. Instead, I only require sales information to be available for both parties in a merger. Therefore I cover a broader range of firms than other research on this topic, which usually employs only large public firms. This is especially meaningful consider that the innovative industries are high tech industries, where most of the deals involve small private firms. I do require the merged firm to be a public firm, so that I can track the post merger performance of the joint firm. Some deals drop out when financial data is missing on the deal date or one year after the deal date. Filtering based on these criteria results in 1895 deals in my sample. The classification of these deals by industry is provided in Table 2-5.

I divide the deals into separate markets based on industry and time so that firms within a market can match with each other but not across markets. The separation by industry is done because firms do not usually consider firms across

industries for merger and the separation by time is needed because the matching algorithm works well when the number of participants is not very large. The separation of markets by industry is done based on the high tech code from SDC platinum. This allows the occurrence of cross industry deals, although their numbers are small. Separation of markets by time is done by year. After the separation, I obtain 72 different markets with 3 to 69 pairs of firms in each market. This separation implies that there are 155,287 potential matches.

Table 2-4: Deal Frequency by Industry

Industry	Frequency
Biotech	454
Computer	753
Electronics	219
Communication	445
Others	24
Total	1,895

It is arguable whether these “markets” are representative of the real consideration set of the firms involved. However, very little is known about the alternative firms that are considered before a merger. Although in a few cases there is open bidding for certain firms, in most cases alternatives partners are never revealed to the public. Therefore any researcher studying partner choice in M&A has to recover the choice set with some assumptions. Since one cannot know the real consideration set, at the very least, any firm that merged in the same period and in the same industry as the firm under consideration can be included. In a sense, merger is similar to a marriage: although best fit matters, timing is also a factor. For example, for a company with pressure to meet earnings targets, finding a partner at the right time is essential. Therefore, it is not unreasonable to pool merger participants close in time and industry together in a market.

Financial information is obtained from Compustat database, and patent data is obtained from the World Intellectual Property Organization (Prabhu, Chandy and Ellis 2005).

2.7.1 Summary Statistics

Table 2-5: Summary Statistics for All Potential and Real Matches

Variable	Mean	Std Dev	Median
nation_match	0.52	0.50	1.00
Industry match	0.13	0.34	0.00
Sum_return_on_assets	-0.26	0.72	-0.02
Sum_book_leverage	1.07	0.78	0.91
Sum_logassets	9.77	3.51	9.61
Diff_return_on_assets	0.38	0.58	0.17
Diff_book_leverage	0.43	0.64	0.27
Diff_logassets	2.72	2.06	2.28
Depth of knowledge	3.51	8.23	1.00
Breadth of knowledge	4.82	11.99	1.00
Similarity of knowledge	0.02	0.08	0.00
Depth of knowledge^2	80.03	525.56	1.00
Breadth of knowledge^2	166.96	1219.30	1.00
Similarity of knowledge^2	0.01	0.06	0.00
N:	155287		

The summary statistics on all potential pairs is in Table 2-6 and on all real pairs is in Table 2-7. Comparing the independent variables in these two tables, I can see that in my sample, firms are on average better off after merger, reflected in more new patents, higher sales, improved ROA, and more R&D investments³¹. However, due to the joint effect of many variables, uni-variate analysis can be misleading because I can not directly predict the effect of a single variable by looking at the summary statistics. One example is nation match: the real data set has higher percentage of pairs from the same country, but it does not take into account the effect

³¹ The sample size for some financial information such as R&D is significantly smaller than the full sample. Therefore some self-selected reporting bias may exist in the sample.

of other variables such as similarity in size, knowledge space, etc. In a subsequent section, I show that firms in the same country are less likely to merge given everything else is the same.

Table 2-6: Summary Statistics for Matched Pairs

Variable	N	Mean	Std Dev	Median
Dependent Variables				
change in new patents	1895	9.63	53.79	0.00
change in new patents2	1895	10.01	59.59	0.00
change in new patents3	1895	8.35	52.98	0.00
change_sales_1	1064	7.83	171.78	1.25
change_sales_2	886	2.99	11.38	1.33
change_sales_3	752	3.51	14.14	1.44
change_roa	954	-0.02	1.96	0.01
change_roa2	795	0.01	0.86	0.01
change_roa3	677	0.11	0.47	0.02
log_change_RnD	378	1.32	2.04	1.33
log_change_RnD2	324	1.38	2.17	1.42
log_change_RnD3	278	1.26	2.90	1.44

Table 2-7: Summary Statistics for Matched Pairs (continue)

Independent Variables	N	Mean	Std Dev	Median
nation_match	1895	0.78	0.41	1.00
Industry match	1895	0.27	0.44	0.00
sum_return_on_assets	1895	-0.24	0.74	0.02
sum_book_leverage	1895	1.05	0.78	0.91
sum_logassets	1895	9.88	3.88	-0.27
diff_return_on_assets	1895	0.34	0.55	0.13
diff_book_leverage	1895	0.39	0.64	0.22
diff_logassets	1895	2.41	1.71	0.00
Depth of knowledge	1895	3.44	7.37	1.00
Breadth of knowledge	1895	5.25	13.23	1.00
Similarity of knowledge	1895	0.04	0.13	0.00
Depth of knowledge^2	1895	66.04	356.44	1.00
Breadth of knowledge^2	1895	202.42	1404.54	1.00
Similarity of knowledge^2	1895	0.02	0.09	0.00

The summary statistics shown in table 2-6 and 2-7 are of original scale. When I include them in the analysis, I drop extreme values (top and bottom 1% values) and

take monotonic transformation on the values to make them of similar scale and range and follow normal distribution (or close to normal distribution).

2.8: RESULTS

The model is applied to the data to jointly estimate the innovation outcome of the 1895 deals (in terms of change in new patents and sales one, two or three years after the merger date) and the matching function of the 1895 acquires and targets separated in 72 markets and capable of forming 155,287 potential matches on the merger date. The results of the matching estimation are included in included in Table 2-8.

Table 2-8: Parameter Estimates of Matching Model

Variables	posterior mean
Nation Match	-0.18 ^c
Industry Match	-0.09
Sum_logassets	-0.12 ^b
diff_logassets	-0.03
sum_return_on_assets	0.00
diff_return_on_assets	-0.30 ^a
sum_book_leverage	-0.40 ^b
diff_book_leverage	0.23 ^b
depth of knowledge	0.15 ^c
depth of knowledge ²	-0.03 ^c
breadth of knowledge	0.03
breadth of knowledge ²	-0.01
Similarity of knowledge	0.61 ^b
Similarity of knowledge ²	-0.94 ^a

Note:

Since not all the posterior distribution are normal, I will not report the standard deviation, but the percentage of the posterior fall in the opposite side of 0 from the mean.

- a. Less than 2.5% of the posterior fall into the other side of 0 from mean
- b. Less than 5% of the posterior fall into the other side of 0 from mean
- c. Less than 10% of the posterior fall to the other side of 0 from mean
- d. The above boundaries are created using quantiles. For example, if mean<0, then a is 97.5 percentile, if mean>0, then a is 2.5 percentile.

Table 9 was created based on 50,000 draws (50,000 burn-in)

Table 10 was created based on 2500 draws (2500 burn-in).

*JE stands for Joint Estimation

Table 2-9: Parameter Estimates for Post Merger Changes in New Patents

Variables	N=one year		N=two years		= three years	
	JE*	OLS	JE	OLS	JE	OLS
Nation Match	0.29 ^c	0.44 ^a	0.31 ^c	0.46 ^a	0.31 ^c	0.46 ^a
Industry Match	0.11 ^a	0.14 ^a	0.05	0.07	0.08	0.11 ^c
sum_logassets	0.04 ^c	0.06 ^a	0.04 ^c	0.06 ^a	0.04 ^c	0.06 ^a
diff_logassets	0.13 ^a	0.15 ^a	0.15 ^a	0.17 ^a	0.14 ^a	0.16 ^a
sum_return_on_assets	0.06	0.08 ^c	0.11 ^c	0.12 ^b	0.12 ^c	0.13 ^b
diff_return_on_assets	0.09	0.15 ^a	0.15 ^c	0.20 ^a	0.20 ^b	0.26 ^a
sum_book_leverage	0.07	0.17 ^a	0.10	0.19 ^a	0.12	0.21 ^a
diff_book_leverage	-0.04	-0.08	-0.06	-0.10	-0.10	-0.13 ^c
depth of knowledge	0.67 ^a	0.67 ^a	0.52 ^a	0.52 ^a	0.57 ^a	0.58 ^a
depth of knowledge^2	-0.03 ^a	-0.03 ^a	-0.01	-0.01	-0.03 ^c	-0.03 ^c
breadth of knowledge	0.08 ^c	0.03	0.02	-0.02	0.02	-0.02
breadth of knowledge^2	0.00	0.00	0.00	0.01	0.00	0.00
similarity_of_knowledge	-1.10 ^a	-1.10 ^a	-0.90 ^c	-0.82 ^c	-2.10 ^a	-2.10 ^a
similarity_of_knowledge^2	0.69	0.78	0.37	0.32	1.70 ^a	1.60 ^b
Error Correlation	0.25 ^a		0.23 ^a		0.23 ^a	

Note: Table 2-9 was created based on 50,000 draws (50,000 burn-in). Since not all the posterior distribution are normal, I will not report the standard deviation, but the percentage of the posterior fall in the opposite side of 0 from the mean.

- a. Less than 2.5% of the posterior fall into the other side of 0 from mean
- b. Less than 5% of the posterior fall into the other side of 0 from mean
- c. Less than 10% of the posterior fall to the other side of 0 from mean
- d. The above boundaries are created using quantiles. For example, if mean<0, then a is 97.5 percentile, if mean>0, then a is 2.5 percentile.

The parameter estimates of the outcome equation in terms of changes in new patents one, two and three years from the merger date are included in Table 2-9. The estimations of the outcome equation in terms of changes in sales for the same period are included in Table 2-10.

As mentioned in 2.5, Bayes Factor can be used for model comparison in the context of Bayesian estimation. Figure 2-2 shows the log(bayes factor) of the joint estimation vs. OLS estimation results for changes in new patents one, two, three years after merger effective dates³². Figure 2-3 depicts the same for growth in sales. Since

³² The ideal way to conduct the joint estimation is to use a system of equations in the outcome stage and iterate it with the matching stage estimation using Gibbs sampling. Here I took a shortcut by running

all the log(Bayes Factor) for patent function and first two years of log(Bayes Factor) for sales function are significantly positive, these figures provide preliminary proof for this paper's assertion that the joint estimation of matching and outcome functions improves the fit as compared to estimating outcome function alone.

Table 2-10: Parameter Estimates for Post Merger Changes in Sales

Variables	N=one year		N=two years		= three years	
	JE*	OLS	JE	OLS	JE	OLS
match_nation	0.24^a	0.29^a	0.25^a	0.29^a	0.27^a	0.32^a
ind_mat_1	-0.11^c	-0.11^c	-0.09	-0.09	-0.07	-0.06
sum_logassets	-0.02^a	-0.01^c	-0.02	-0.01	-0.02	-0.01
diff_logassets	0.02	0.03^c	0.01	0.01	-0.02	-0.01
sum_return_on_assets	-0.06	-0.06	-0.09	-0.10	0.02	0.02
diff_return_on_assets	-0.03	-0.02	-0.04	-0.04	0.10	0.11
sum_book_leverage	0.04	0.06	0.11	0.13	0.11	0.14
diff_book_leverage	-0.04	-0.05	-0.09	-0.10	-0.09	-0.10
depth of knowledge	-0.01	-0.01^c	0.23^b	0.24^b	0.27	0.28^b
depth of knowledge^2	-0.03^b	-0.03^b	-0.03^c	-0.04^c	-0.04^c	-0.04^c
breadth of knowledge	-0.13	-0.12	-0.09	-0.11^b	-0.05	-0.07
breadth of knowledge^2	0.00	0.00	0.00	0.00	0.00	0.00
similarity_of_knowledge	0.02^b	0.02^b	-0.49	-0.49	-0.67	-0.65
similarity_of_knowledge^2	-0.09	-0.10	0.63	0.64	0.87	0.84
correlation	0.09^a		0.07^a		0.08^a	
variance	1.10	1.10	1.20	1.20	1.40	1.40
log marginal likelihood	-588.68	-593.46	-514.50	-516.92	-497.12	-492.63

Note:

Since not all the posterior distribution are normal, I will not report the standard deviation, but the percentage of the posterior fall in the opposite side of 0 from the mean.

- Less than 2.5% of the posterior fall into the other side of 0 from mean
- Less than 5% of the posterior fall into the other side of 0 from mean
- Less than 10% of the posterior fall to the other side of 0 from mean
- The above boundaries are created using quantiles. For example, if mean<0, then a is 97.5 percentile, if mean>0, then a is 2.5 percentile.

Table 2-10 was created based on 2500 draws (2500 burn-in).

*JE stands for Joint Estimation

joint estimation using new patent outcome one year after merger, save the error terms in 1 of every 10 iterations, and use these saved error terms as unobserved private synergy in the other outcome estimations. The implication of this method will be discussed shortly .

The unobserved strategic fit significantly improves the ability of the model to explain new patent generation by the merged firm from one to three years after the merger, although the effectiveness decreases over time. The error term also significantly improves the model fit for the post merger change in sales one and two years after merger, but is not useful in year three. I also apply this method on post merger change in return on assets and R&D investment levels from year 1 to 3, but none of these is significant, therefore the results are omitted here.

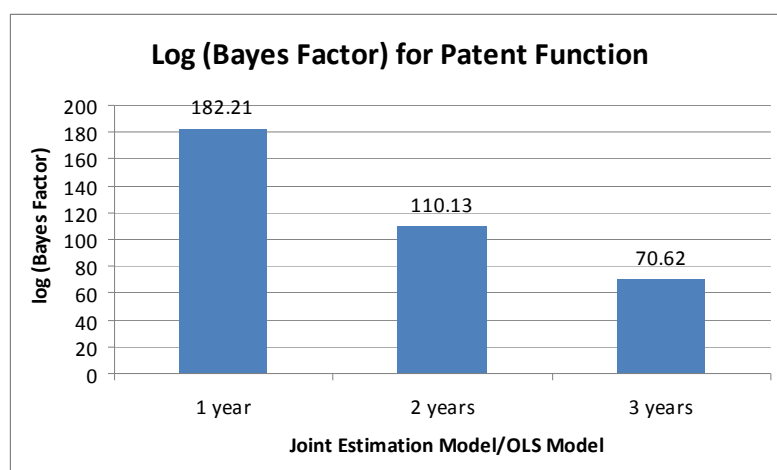


Figure 2-2 Bayes Factor for Patent Function

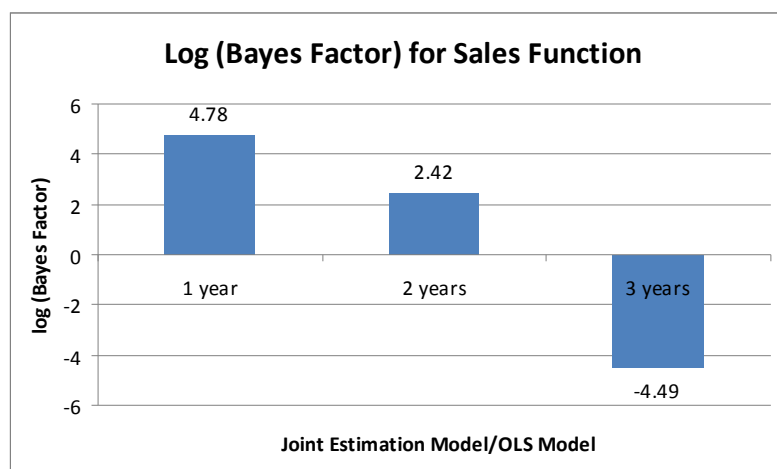


Figure 2-3 Bayes Factor for Sales Function

The direct interpretation of the findings in Figure 2-2 and Figure 2-3 is that the unobserved strategic fit³³ strongly affect the innovative abilities of the firm, and the effect wanes over time. Similarly, the unobserved strategic fit affects the post merger sales, but the effect is smaller than its effect on patents, and the effect dies down faster (after two years). The strategic fit variable does not affect R&D spending or Return on Assets. Of course the concern here is that the error terms are generated from the joint estimation of one year post merger patent generation, so these errors might be influenced more by patent measures. That might explain why the effect of unobserved fit is so strong on new patent generation and much less on other variables. This will be corrected in the future by estimating a system of equations in the outcome stage. Nevertheless, the parameter estimates are fairly consistent over time and across measurements. In the subsequent paragraphs, I discuss the main results and observations from Table 2-8, 2-9 and 2-10.

Nation matching (two firms belonging to the same country) decreases the probability of two firms forming a joint entity, after controlling for financial and knowledge based variables. However, in the patent and sales outcome functions, nation matching has a positive effect (around 0.30). From the integration perspective, this finding indicates that country related factors such as cultural similarity reduces integration frictions and increases the chance of achieving positive post merger results. Another interesting finding is that the effect of nation matching on patent outcome estimated by the structural model is much less than that estimated by OLS, indicating that there is significant matching induced bias in the OLS estimation of nation matching effect.

³³ The “unobserved strategic fit” is just a suggestive name. The variable is an aggregate of all unobserved variables that influence the M&A decision, including internal and external factors.

Similarity of knowledge is positively evaluated in the merger partner selection criteria, but negatively affects the combined firm's ability to generate new patents in one, two and three years after the merger effective date. The effect of similarity of knowledge is not linear though, with a positive effect at low levels of similarity and a negative effect at high levels of similarity. This suggests that firms prefer partners with similar knowledge base as their own, but they also realize that too much similarity can prevent further learning and induce cannibalization. Therefore, they avoid potential partners that very closely resemble themselves.

The fact that knowledge similarity negatively affects patent outcome and non-monotonically affects matching estimation (in Table 2-9 and Table 2-10) suggests that managers do not fully anticipate the problems in integrating firms with similar knowledge base. Managers seem to prefer similar firms with the expectation of creating synergies, but they do not seem to materialize these synergies. This suggests that managers do not anticipate the difficulty in integrating similar firms. Similar knowledge base may result in overlapping and redundant research (Rindfleisch and Moorman 2001) and turnover of key scientists. Cassiman et al. (2005) use in-depth surveys and finds a detrimental effect on R&D level and efficiency between technical substitutive partners. They find that when merged firms are technologically substitutive, key employees tend to leave more often, the R&D portfolio becomes more focused, the R&D horizon becomes shorter and internal funds available to R&D decrease. This paper provides empirical support to their survey based findings. In contrast, Prabhu, Chandy and Ellis (2005) find a non-monotonic relationship between knowledge similarity and innovation outcome. This may be because they study deals in only one industry whereas Cassiman et al (2005) and this paper study deals in multiple industries. A related observation is that similarity of knowledge leads to increase in sales in the first year, which makes one suspect that related mergers are not

so much for innovation purpose, but for sales growth. However, this effect is not long lasting.

One thing that the managers anticipate correctly is to pursue partners that deepen their knowledge base. This variable is positively significant in both matching (0.15) and patent outcome functions (around 0.60), suggesting that specialization is indeed effective in enhancing innovation. However, this effect is non-monotonic suggesting that firms with too much depth of knowledge are not preferred partners, and such matches do not end up being successful. Interestingly, the effect of depth of knowledge does not show up in sales until the second year after merger, and the effect of knowledge similarity dominates the knowledge related effects on sales in the first year. This suggests that merging with firms with similar technologies is a desirable objective in the short run, probably by enhancing market share and gaining market power. However, in the long run, the effect of new knowledge catches up, and reduction in new patents signals a potential problem that will eventually cause a decrease in sale (probably due to lack of cutting edge technology or new products compared with major rivals).

Another interesting result relates to breadth of knowledge. I find that breadth of knowledge has a marginal positive significance on patent outcome in the first year (0.08) but has no effect in the matching estimates or the OLS estimates. The different estimates for knowledge breadth in matching and patent outcome equations suggests that managers do not merge to increase breadth of knowledge, but breadth of knowledge does have a positive effect on innovation outcome. On the other hand, the different estimates for knowledge breadth in the joint estimation and OLS estimation of patent outcome equation suggests that the OLS estimation of this variable is biased due to matching induced endogeneity. This suggests that the findings of breadth of knowledge not increase a firm's ability to generate innovation from acquisition in

Prabhu et al. (2005) may be biased due to matching induced endogeneity as in my OLS estimation. The matching model controls for this bias and finds that breadth of knowledge marginally increases a firm's ability to generate innovation from acquisition, though the effect is short lived.

Other significant findings are that large mergers (measured by sum of log assets) are disliked by firms, which means that firms do not go after the largest partners they can find. Although such deals can make the headline of newspapers, they are not majority of the deals. More cautious and frequent approach of M&A is to find small or medium size partners and build up gradually. The patent outcome estimates suggest that if the size of the two firms differs greatly (measured by absolute difference of log assets), then the influence on innovation outcome is greater. This might be because the larger firm has deeper pocket to support the innovative ideas of the smaller firm, and the larger the size difference is, the easier the integration (because there is no struggle for control power, the larger one naturally dominates the new firm and can focus energy on supporting the new additions). Similarly, the parameter estimation on difference of return on assets in matching function shows that acquiring firms are cautious in picking target firms (usually acquiring firms are large established ones, which tend to have positive profits, and the target firms are smaller and more innovative with negative profits). Because of this cautious approach, the better performers among target firms get picked by better acquirers, leaving the not so good targets (in terms of profit generating abilities) to lesser acquirers. Looking at the patent outcome though, difference in profit levels are positively correlated with new patent generating abilities of the firm, which suggests that profitable acquirers can finance the research ideas of the smaller target better than a struggling acquirer. Therefore financially solid acquirers might consider taking more risks when selecting merger partners.

2.9: SUMMARY

In this paper I control for the endogenous matching of merging firms to estimate the influence of various drivers of innovation output in a merger. I use a structural matching model to explain the sorting of firms into merging pairs. Then I evaluate the innovation outcome of the merger based on the matching process. The matching function and the innovation outcome function are linked through error correlation. This joint specification reduces the bias in estimation of innovation outcome by endogenizing the sorting of firms and helps determine the drivers of integration process. A Bayesian method is developed to estimate the model and simulation is used to prove the ability of the estimation method to recover the parameters. The model is estimated on 1895 deals in five high-tech industries.

Based on preliminary analysis, I find that unobserved strategic fit in a merger has a strong effect on post merger firm innovative abilities, measured by number of new patents one, two and three years after the merger. The unobserved strategic fit also influences the sales of the joint firm after merger. However the effect wanes in two years time. The likely reason is that innovation research is more long term than sales, therefore is affected by the firm's long term strategic goal and the resource allocation accordingly. In comparison, sales is a more immediate and visible goal of the firm, and get influenced by firm's internal, external, competition factors more easily. Therefore the effect on sales growth is less sustainable.

In terms of the managerial decisions regarding merger partner selection, I find that firms have been doing well in identifying partners that can deepen their knowledge space and help them develop expertise in certain area(s). Such strategy brings payoff reflected in more new patents and increase in sales. However, merging firms seem too keen on foreign merger partners and partners with similar technology knowledge as themselves. The merger outcome shows that domestic mergers run less

cultural related risks, and less related mergers won't hurt innovation as much as the related ones do. Of course the "relatedness" is measured between firms in the same industry, which is considered to be related by some earlier researchers. It is also possible that these related mergers happened for market power or reasons other than promoting innovation, since related merger do improve sales in the short run(one year). However managers in high tech companies need to keep in mind that in the long run, the knowledge expertise may determine the fate of the company.

2.10: LIMITATIONS AND FUTURE RESEARCH

Although the game setup is fairly general and allows the outside option of not merging with any other firm but stay alone, my current estimation setup does not include firms that did not participate in mergers. The control variables in both matching and outcome stages are not exhaustive and I may have left out many important factors that are considered by managers. However, due to the large scale of the study, it is hard to complement the financial data with either survey or manually collected data. Fortunately my model design of correlating matching model with outcome model partially makes up for the deficiency caused by missing variables. Echoing Sorensen (2007), the current matching game setup is a static equilibrium model, and it does not have dynamic features of the market or the repetitive participation of some firms.

In the future I plan to include some randomly selected firms in each market as representatives of the "outside option". The inclusion of these variables will allow me to estimate the threshold conditions for firms to enter a merger. I can also study the performance of merged firms in comparison to the firms that did not merge. The current model comparison is done mainly through Bayes Factor. To gauge the predictive ability of the model, some out of sample predictions can be done using the model. Besides the merger and acquisition problem, the matching model and the joint

estimation method can be applied to many other marketing topics, such as alliances, joint ventures, selection and evaluation of retailers and wholesalers, collaboration of clients and their ad agencies, as well as faculty co-authorship.

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CHAPTER 3
REVIEW OF MERGER AND ACQUISITION RESEARCH IN MARKETING
LITERATURE

3.1 INTRODUCTION

Mergers and acquisitions (M&A) are an important business phenomenon, as evidenced by the large and increasing volume of M&A activities over the years. As illustrated in Figure 3-1, the number of M&A deals in US started picking up in the mid 1990s, together with the total deal value. The trend peaked at 2006 with 12,000 deals and over \$1.4 billion in value. Even though firms can grow via acquisition, this topic is not a familiar phenomenon to many marketing scholars, and marketing is not the first functional area to enter managers' mind when they think of M&A deals.

In this review paper, I survey the M&A related research published in top marketing journals and discuss how it is related to the research in other business disciplines that study M&A phenomenon. This survey should help readers in appreciating the views of marketing researchers in the M&A field and help them incorporate M&A topics in their own research.

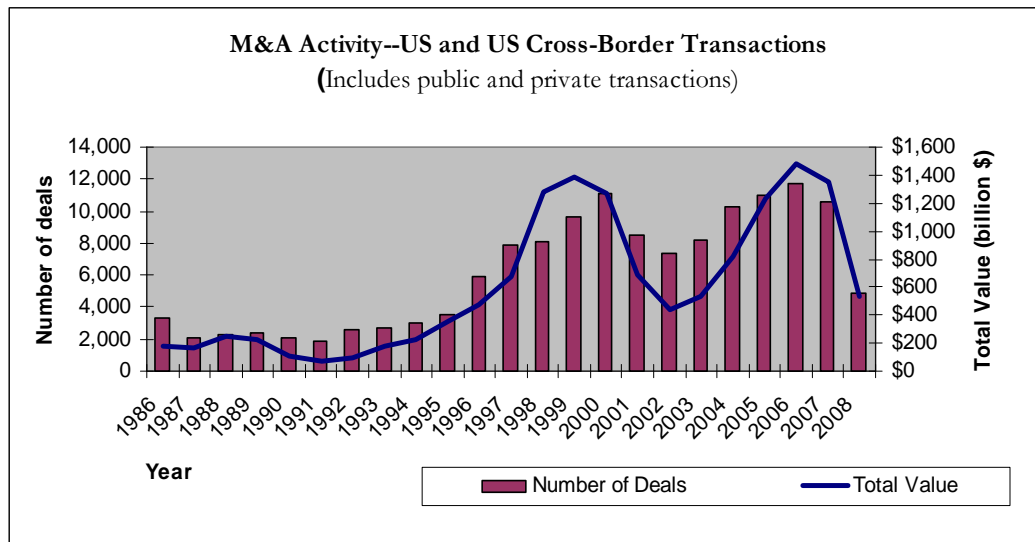


Figure 3-1 US M&A Activities

First, I will start by defining Merger and Acquisitions. The dictionary definition of M&A is quite general: “[A merger is a] fusion of two companies or, sometimes, an acquisition or a takeover of one company by the other” (Reuters 1982: Glossary of International Economic and Financial Terms).

An alternative definition of M&A emphasizes more on the process: The expression M&A has been established to represent both joint agreement between the management of two firms to merge that is submitted to the shareholders for approval (including consolidation where the separate firms are dissolved into a new joint corporate identity) and acquisition of one firm by another through tender offer (i.e., publicly announced takeover bid) (Larsson 1990, cf. Jensen 1985).

From these definitions, I can see that M&A refers to two categories of merger activity: mergers by consolidation and mergers by acquisition. Scholarly literature generally uses the term ‘merger’ to include both consolidation and acquisition activity, but this review uses the term M&A (mergers and acquisitions) to encompass both these activities as a single business phenomenon. This is not to omit the differences between e.g. mergers, acquisitions and takeovers. Rather, the analysis concentrates on the effect M&A, as a whole, has on the organization of economic activity.

The structure of this paper is as follows: Section 3.2 reviews relevant theories in M&A from various fields such as economics, strategy, and finance. Section 3.3 reviews M&A related research in top marketing journals. Section 3.4 summarizes the findings from the marketing literature and suggests future research directions.

3.2: REVIEW OF M&A THEORIES

The area of merger and acquisition attracts wide attention from a large variety of fields such as economics, finance, organizational behavior and law³⁴. Parvinen

³⁴ Due to space limitation, many theories that are less relevant to marketing research, such as law and human resource literature are not reviewed here.

(2003) provides a comprehensive review on M&A and lists various theories regarding the explanations and justifications for M&A. Here I will summarize major schools of thought in the other literature and their relationship with marketing. These schools of thought can be classified as follows: strategy theories; process theories; financial theories; governance theories; and competence-related theories.

3.2.1 The strategy theories

According to Parvinen (2003), management theories are the first and foremost approach for M&A. Developed in 1980s and 1990s, strategy paradigms include *competitive strategy* (Porter 1980, 1985, 1996, Porter and Fuller 1986, Besanko et al. 1990) and *resource-based strategy* (whose antecedents include Penrose 1959, Rumelt 1974, Nelson and Winter 1982 and major contributions include Hamel and Prahalad 1990, 1994, Singh and Montgomery 1987, Teece 1982, Barney 1988, Rumelt, Schendel and Teece 1994). These schools of thought are often cited as the theoretical foundation in marketing M&A studies, such as Capron and Hlland (1999), Bahadir, Bharadwaj and Srivastava (2008), Swaminathan, Murshed and Hlland (2008), Silk and Berndt (1993), Singh and Zhu (2008), Katz (1991) and Chen and Zeng (2003).

Key M&A related corporate strategy research areas include efficiency gains, risk diversification, operating synergies, competitive realignment, competence, resources, information realignment, and redistributive realignment (Weston et al. 2001). The two most important M&A related strategy themes are relatedness and synergy.

Earlier papers in the spirit of the resource-based theory of the firm (Rumelt 1974, 1982, Bettis 1981, Nelson and Winter 1982) found that large firms with unrelated diversification (often as a result of M&A activity) were outperformed by firms with related activities on the whole. Porter (1987) argued that value can arise from appropriate portfolio management, restructuring, sharing of activities and the

transfer of resources. The relatedness of activities and the strategic and organizational fit are also further developed (Porter 1996). Based on these empirical findings, it is argued that relatedness is a driving force behind the successful co-existence between merged firms in certain industries such as pharmaceuticals. However, relatedness served as an empirical measurement for a more fundamental explanation of the source of merger gain, which is summarized below as synergy.

The notion of synergy has derived from two particular intellectual orientations. The first is the theory of differential managerial efficiency (Teece 1987), which argues that M&A gains are due to more efficient organizations and pooling of complementary resources (Gammelgaard 2001). The other relates to the replacement of inefficient management following M&A, i.e. the operation of an allocation market for corporate control (Fama 1980, Manne 1965, Walsh 1988, 1989). Further, M&A synergies have been categorized into operational synergies³⁵, collusive synergies³⁶, managerial synergies³⁷ and financial synergies according to their measurability and the ability to generate benefits (Weston et al 2001, Larsson and Finkelstein 1999). In essay 1 in the dissertation, I developed the intensification and expansion factors as synergy measures partially based on the relatedness of the acquirer's and target firm's product and research portfolios. Of course these measures are proxies for actual/realized synergies, whose realization depends on other factors such as successful integration.

3.2.2 Process theories

The process theories (Hunt 1990, Haspeslagh and Jemison 1991, Pablo 1994, Larsson and Finkelstein 1999) were spurred by the strategy school's inability to emphasize the significance of the M&A process. The basic argument is that the M&A process itself can be an important determinant of the various M&A outcomes (Jemison

³⁵ Resulting from economies of scale for example in production, R&D, staff functions and marketing.

³⁶ Resulting from increased market power and bargaining power.

³⁷ Corresponding to the efficiencies from the market for corporate control

and Sitkin 1986). As recognized by Puranam (2001, p.6-7), one of the central tenets in the process approach is that the acquisition of the equity of another company does not automatically lead to the creation of necessary links between the resources of the merging companies. Costly transactions, most importantly the alignment of incentives, the creation of coordination mechanisms and the adjustment of information flows governing the use of the resources, are needed (Ranft 1997, Zollo and Singh 2000).

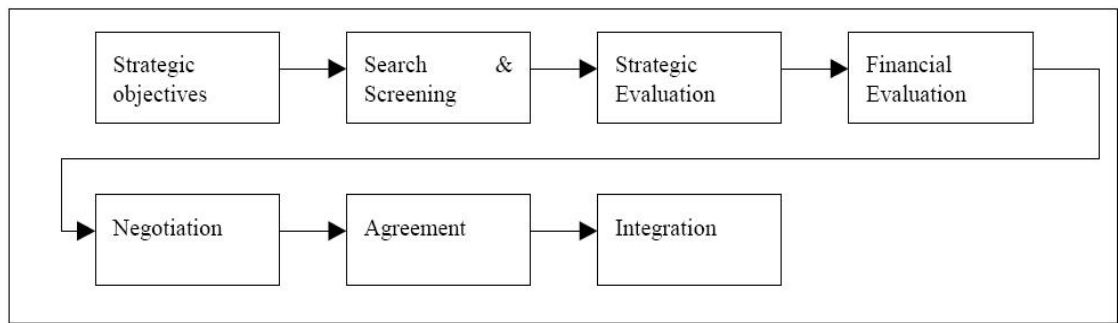


Figure 3-2: Conventional View of the M&A process (Haspeslagh and Jemison 1991)

Before the rise of the process stream in the 1980s, the conventional M&A literature argued for a sequential, one-process view of M&A as shown in Figure 3-2. Proponents of the process stream of M&A, however, argued that there are at least two different processes, namely the decision making process and the integration process (Haspeslagh and Jemison 1991, pp.12).

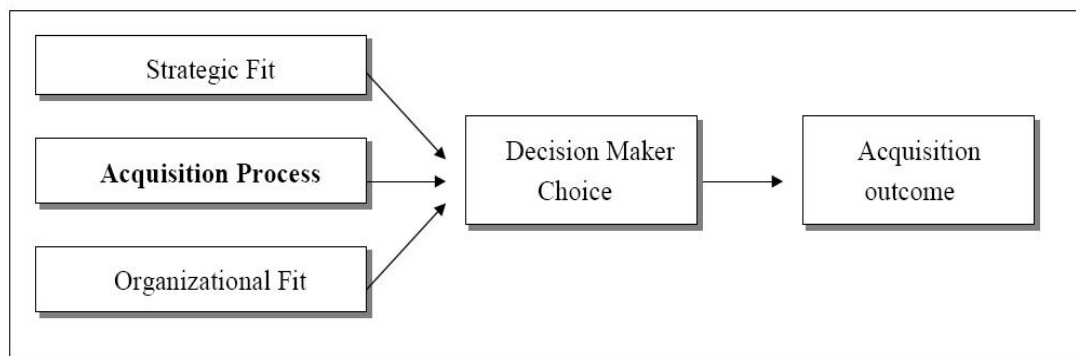


Figure 3-3: The Process Streams' View of the Embeddedness of the M&A Process in a Certain Strategic and Organizational Fit (Jemison and Sitkin 1986)

Figure 3-3 presents the process stream's views of embedding the acquisition process in certain strategic and organizational fit and Figure 3-4 presents a coarse division of acquisition process problems. Both of these views encompass the same sequential steps as in the conventional view on the M&A process.

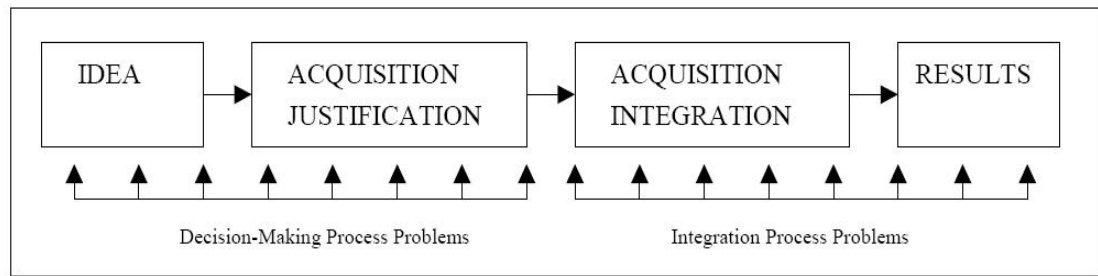


Figure 3-4: The Process Streams' View of the M&A Process Problems (Haspeslagh and Jemison 1991)

3.2.3 Financial theories:

Financial theories include capital markets perspective, corporate finance perspective and valuation theory. The capital markets perspective employs capital market theory to analyze M&A success, the role of globalizing capital markets in the formation of cross-border M&As, and the use of capital market instruments in performing as well as preventing M&A transactions. The key source of financial synergy from M&A are argued by a) reduced capital cost as internal financing is cheaper than external financing, b) the utilization of tax shield and c) the increase in the debt capacity of the merged company. In essay 2 of the dissertation, I do not emphasize the financial synergy as much as economic synergies. However, I include financial synergy terms in the balance model specification as a robustness check.

Corporate finance literature develops agency theory and transaction cost economic theory which lie in the realm of institutional and organizational economics. Agency theory argues that problems arise in M&A situations when managers' and owners' interests are not congruent (Holmstrom 1979, Fama 1980). This may result in non-value creating acquisitive behavior due to e.g. empire-building acquisitions (Roll

1986) and managerial risk reduction through diversifying M&A (Amihud and Lev 1981). Managerial hubris and empire building have been attributed as the most important motivations behind M&A behavior. Roll (1986) elevated hubris³⁸ as an equally important motivation for M&A as taxes, synergy and removing inefficient management. Hayward and Hambrick (1997) relate the amount of acquisition premiums paid to the extent of CEO hubris, and their findings imply that hubris might actually be a primary reason for acquisition price-related M&A ‘failures’.

3.2.4 Governance theories:

Governance theories are many institutional and organizational theories related to governance of firm that are classified together by Parvinen (2003). The most prominent branches in this literature include the *neoclassical* firm-as-a-production function literature; *the nexus of contracts view*; the formal and positivist *principal-agent theories*; early *incomplete contracting* theory characterized by the coordination problem; *property rights theory*; and *transaction cost economics*.

The formal and positivist *principal-agent theories* include Hart and Holmström (1987), Ross (1973), Holmström (1979, 1982), Eisenhardt (1989); Jensen (1983, 1985); Fama and Jensen (1983); Jensen and Meckling (1992) and Harris and Raviv (1978). With the incentive arguments, the principal-agent framework has implications for M&A at the level of the individual manager as discussed in the financial theories section above.

The early discussion of *incomplete contracting* and coordination problem (Coase 1937; Simon 1945, 1951; Malmgren 1961) act as the basic foundations for the boundaries of the firm discussion. They introduce the key semantics and the central

³⁸ **Managerial hubris** is the unrealistic belief held by managers in bidding firms that they can manage the assets of a target firm more efficiently than the target firm's current management. Managerial hubris is one reason why a manager may choose to invest in a merger that on average generates no profits (Barney and Hesterly, 2008).

idea of incomplete contracting to the more recent transaction cost economics and property rights literature.

Transaction cost economics (Williamson 1971, 1975, 1977, 1985, 1986, 1991, 1996) has had significant influence over the development of M&A theories.

Transaction cost economics assumes that contracts can be incomplete and lead to hold-up problems. If the two parties in transaction want to avoid transaction cost, they can merge with each other and internalize the market transaction costs. Transaction cost theory has been applied to vertical and international M&A cases (Klein, Crawford and Alchian, 1978). More specifically, the focus has been on synergistic efficiency considerations, and mergers have been analyzed with respect to their transaction cost economic properties (Richter 1999, p. 51-55). Richter's logic manifests how synergies between two separate businesses can and indeed lower the transaction costs of using a factor of production (e.g. the same investor, the same external consulting services, and the same distribution channel), thereby encouraging diversification into seemingly unrelated businesses. Similarly, potential benefits from diversification may arise if one business creates such positive externalities (e.g. a great motivation within a research department) that can be internalized by the other business in the form of productivity enhancing spillover effects.

3.2.5 Competence theories

Parallel to the governance perspective, the theory of the firm has also been enriched by theories known as the competence-(or, alternatively, resource-, capability-, or knowledge-) based views of the firm. In these theories, the conceptual focus is on the efficient use of bounded knowledge³⁹ and on adapting to unanticipated change. They consist of the *resource-based perspective* of the firm (e.g. 'the resource

³⁹ In game theory, bounded rationality is a concept based on the fact that rationality of individuals is limited by the information they have, the cognitive limitations of their minds, and the finite amount of time they have to make decisions (Simon, 1957).

dependence' view by Pfeffer and Salancik 1978; also Wernerfelt 1984; Dierickx and Coll 1989); the *dynamic capabilities perspective* (Nelson 1991; Teece, Pisano and Shuen 1990); the *knowledge based theory of the firm* (Kogut and Zander 1992; Nonaka and Takeuchi 1995); and the *core competencies* approach (Hamel and Prahalad 1990; Sanchez and Heene 1997).

The main messages of this school of thought are:

- Firms exist because they produce and utilize knowledge, particularly tacit knowledge, more efficiently than markets (Kogut and Zander 1992).
- Moreover, a routine is thought of as 'the skill of an organization'. Capabilities (competencies, dynamic capabilities, higher-order organizing principles) are meta-routines that represent a firm's capacity to sustain a coordinated deployment of routines in its business operations (Foss and Foss 2000).
- The boundaries of the firm are determined by knowledge-based considerations, not by mere contracting related to the solving of various incentive conflicts. Knowledge assets that are non-contestable and idiosyncratic are usually governed within the firm, whereas complementary but dissimilar knowledge assets are best obtained through an inter-firm cooperative arrangement. (Foss and Foss 2000)
- Firms' internal organization is best understood as a matter of creating a shared context (e.g. in terms of organizational culture) that can help in integrating and utilizing essentially local knowledge to build and leverage core competencies (Foss and Foss 2000; Sanchez and Heene 1997).

The competence view provides a clear definition of boundaries of firm and therefore provided solid foundation for justification of M&A. The most conspicuous is the 'synergy' explanation for M&A, which essentially states that relatedness between firms is the key to M&A success (Lubatkin 1983, Singh and Montgomery 1987, Chatterjee 1986). Similarly, the role of M&A in acquiring otherwise hard-to-get

inimitable and distinctive resources and competencies has been acknowledged. The knowledge-based theory has been used by many M&A researchers as the foundation for R&D motivated acquisition (Prabhu, Chandy, Ellis 2005). A distinctive stream of literature has concentrated on the transfer and acquisition of unique technologies through M&A (Hagedoorn 1990, Hagedoorn and Sadwsky 1999, Laamanen and Autio 1996, Laamanen 1997). Organizational learning through M&A (Kusewitt 1985, Zollo and Singh 2000, Haleblan and Finkelstein 1999) and M&A in technological and organizational innovation (Kabiraj and Mukherjee 2000) are related explanations. Many of these justifications for the existence of M&A rely on and emphasize the role of tacit knowledge in value creation.

The preceding literature review shows an interesting phenomenon: many theories overlap and cross-fertilize each other. For instance, agency theory bellows (???) to corporate finance and governance theory, resource-based view is referred to in both strategy and competence theory. Many of the theories originate from the same school of thought and found applications in many different disciplines. This review therefore only serves as a rough road map of theories related to M&A, rather than bullet-proof standard of classification. Although not all of the theories are equally utilized by marketing scholars in their work, the survey provides useful background knowledge for anyone who wants to conduct research in this area. It is important to realize the existence of alternative theories while relying on one or two for an empirical study.

3.3: REVIEW OF M&A RESEARCH IN MARKETING

The survey in marketing literature is conducted by first selecting ten influential journals in marketing, and then finding all the M&A relevant articles in those journals.

For journal selection, I combined the rankings in Baumgartner and Pieters (2003) and Social Science Citation Index (SSCI) Article Influence Score.

Baumgartner and Pieters (2003) ranked marketing journals by the citations they received in three time periods. I used the most recent period of the three (1996-97). These authors also further classified the journals into 5 subareas (core marketing, managerial marketing, marketing applications, marketing education). For the purpose of my study, I selected journals based on their overall rankings, and did not include journals that are mainly managerially oriented (such as Harvard Business Review).

I supplement my article selection with the SSCI 2008 Journal Citation Ranking, Social Science Edition. I accessed the ranking under the subject category “Business” via the eJournal Web of Science by the Institute for Scientific Information. I used the field “Article Influence Score” for my ranking, and since the ranking contains journals from all business fields, I selected journals that are largely marketing focused.

With these two journal ranking sources, I come up with the list of ten journals included below. Although the rankings vary across the two sources, they are largely representative of the most influential journals in marketing.

Top 10 Influential Journals in Marketing

- Journal of Marketing
- Journal of Marketing Research
- Management Science
- Marketing Science
- Journal of Retailing
- Industrial Marketing Management
- Journal of Advertising Research
- Marketing Letters

- International Journal of Research in Marketing
- Journal of Product Innovation Management

Next, I searched these journals for articles published between January 1990 and January 2010 that contained the key words “merger” or “acquisition” in title or keyword (subject terms). I excluded the articles that use “acquisition” in the context of customer, knowledge or information acquisition. I also excluded some articles from “Management Science” that are obviously in fields of finance, operational research or human resource management. With the above criteria, I ended up with 28 articles.

As this summary indicates, a wide range of marketing topics, especially brands and markets, are related to M&A activities. As I will discuss later in the paper, many mergers and acquisitions are motivated by the acquiring company’s desire to strengthen its market position and obtain brands of the target company. Therefore it is not surprising to see these two topics receiving the most attention in the literature.

Rather than review the literature from the viewpoint of these marketing topics, I do so in the M&A process framework. The frequency of marketing topics studied in the 28 selected articles is summarized below.

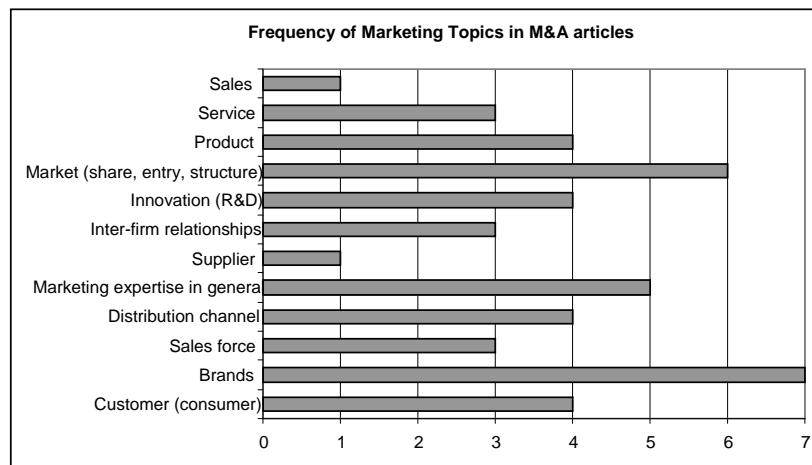


Figure 3-5: Frequency of Marketing Topics in M&A Articles

Table 3-1 M&A Research in Top 10 Marketing Journals (Page 1)

Journal	No	Article	Method	Focus of the Study	Findings and how the article relates to M&As
Journal of Marketing	1	Anderson and Naru (1990)	Conceptual and survey	Distributor and Manufacturer firms working partnerships	Manufacturer and Distributor firms are found to have relative dependence, and cooperation is antecedent of trust. The consolidation trend in the wholesale-distribution industry is used as motivation for the study
	2	Capron and Hulland (1999)	case and quantitative (survey)	Redeployment of brands, sales force and general marketing management expertise following horizontal acquisitions	The authors found that highly immobile resources are more likely than less immobile resources to be redeployed. Furthermore, resources tend to be redeployed from the acquirer to the target more often than in the reverse direction. Finally, marketing resource redeployments have minimum effect on cost-based synergies, but a positive impact on revenue-based synergies.
Journal of Marketing Research	3	Homburg, Bucerius (2005)	quantitative (survey)	How marketing integration affects post-merger performance	The study of post-merger integration in marketing on M&A performance, mediated by integration outcomes, shows that market-related performance after the merger or acquisition has a much stronger impact on financial performance than does cost savings. In addition, the extent of integration is beneficial in terms of cost savings but detrimental in terms of market-related performance.
	4	Prabhu, Chandu and Ellis (2005)	quantitative (secondary data)	Do acquisitions increase, decrease, or have no effect on innovation?	For firms that first engage in internal knowledge development, acquisitions can help innovation
Journal of Marketing Research	5	Bahadir, Bharadwaj and Srivastava (2008)	quantitative (secondary data)	What affect the value of a target firm's brands in M&As?	Acquirer and target marketing capabilities and brand portfolio diversity have positive effects on a target firm's brand value. The positive impact of acquirer brand portfolio diversity and target marketing capability is lower when the M&A is synergistic than when it is non-synergistic.
	6	Sorescu, Chandy and Prabhu (2007)	quantitative (secondary data)	The role of product capital in M&As	This article shows that firms with high product capital (i.e., those with greater product development and support assets) make smarter acquisition decisions. Such firms are better at selecting targets with innovation potential and then deploying this potential to gain competitive advantage. These firms also perform better in the long-term financial measures.
Journal of Marketing Research	7	Swaminathan, Murshed and Hulland (2008)	conceptual and quantitative (secondary data)	investigate how strategic emphases of merging firms (marketing or research and development) create value in a merger context	Strategic emphasis alignment is a key construct that facilitates value creation. When merging firms have low strategic emphasis alignment, value is enhanced when the merger motive is diversification. In contrast, when merging firms have high strategic emphasis alignment, value is enhanced when the merger motive is consolidation.

Table 3-2 M&A Research in Top 10 Marketing Journals (Page 2)

Journal	No	Article	Method	Focus of the Study	Findings and how the article relates to M&As
Management Science	8	Rao, Mahajan and Varaiya (1991)	methodological and illustrating example (survey data)	Develop a balance model for evaluating firms for acquisition	The appropriateness of this approach in the decision of one firm to acquire another firm is investigated using experimental methods. The context of the cosmetic industry is used in this empirical application. Results indicate that the balance model is quite suitable in describing the acquisition decision.
	9	Hennart and Park (1993)	quantitative (secondary data)	Examines the factors influencing the way Japanese firms enter US market (taking over existing local firms, or setting up new ventures)	The results suggest that acquisitions are used by Japanese investors with weak competitive advantages, while investors with strong advantages find that green-field investments are a more efficient way to transfer these advantages to the U.S. Acquisitions are also chosen to enter industries with either very high or very low growth rates, when entry is at a scale that is large relative to the parent, and when entry is into a different industry.
	10	Markovitch, Steckel and Yeung (2005)	quantitative (secondary data)	Study the role stock price variation plays in managerial decision making.	Drug firms whose stock underperformed the industry react differently than drug firms with high-performing stocks. Specifically, laggards tend to implement more changes to their current product portfolio and distribution than high-performing firms. The more laggards underperform, the more they implement acquisitions aimed to produce immediate improvement in the firm's product portfolio. In contrast, drug firms whose stocks outperform the industry tend to make fewer changes to their current portfolio and distribution. Instead, they focus more on long-term research and development and marketing of existing products.
	11	Zhao (2009)	quantitative (secondary data)	Examine whether technological innovation is a motivating factor in firms' acquisition decisions and how an acquisition (or an acquisition withdrawal) affects technological innovation in subsequent years.	The author find that firms engaging in acquisition activities are less innovative and have often experienced declines in technological innovation during the years prior to the bid. Among the bidders, the relatively more innovative ones are less likely to complete a deal. During the three years after the bid, successful bidders do not underperform matching firms, whereas failed bidders significantly underperform their non-bidding peers. And formerly less innovative bidders benefit more from acquisitions.

Table 3-3 M&A Research in Top 10 Marketing Journals (Page 3)

Journal	No	Article	Method	Focus of the Study	Findings and how the article relates to M&As
Advances in Consumer Research	12	Papavasileiou, Swain, and Bhattacharya (2008)	Experimental	Consumer's reactions to acquisitions of socially responsible companies	The authors found that consumer reactions to acquisitions are varied, depending both on the companies' profiles as well as personal attributions and Social Value Orientation (SVO). This paper suggests that the matching between the two corporate images as well as the naming strategy (combined vs. separate) affect consumer's perceptions of M&As. Choosing the less favorable naming strategy may harm both consumers' attitudes and purchase intentions.
	13	Papavasileiou (2009)	Experimental	Corporate Syntheses: Consumers' Role in Mergers and Acquisitions	The article finds both scale and particularly scope economies are highly significant in the operations of U.S. advertising agencies. In the industry large, fully efficient firms created and produced more than half of all the national advertising utilized in U.S. in 1987, while vast numbers of small agencies appear to operate with substantial cost disadvantage. The implication for merger is that small advertising agencies should have incentives to merge to take advantage the scale and scope economy.
Marketing Science	14	Silk and Berndt (1993)	quantitative (secondary data)	How important are economies of scope and scale in advertising agency operations?	Results show that ignoring the endogeneity of market structure severely underestimates the impact of additional competitors on prices, with the competitive interaction parameters doubling in magnitude after the correction procedure. The downward bias in the competitive parameter can have important implications for horizontal mergers, which may incorrectly appear innocuous when using a model that ignores the endogeneity of market structure.
Journal of the Academy of Marketing Science	15	Singh and Zhu (2008)	quantitative (secondary data)	The relationship between prices and market concentration in the auto rental industry	The book sheds light on the role of brands and marketing factors as drivers of shareholder value within a brand-intensive industry setting. The author developed a methodology to define a firm's brand-related acquisition rationale, which links to balance model with a choice based conjoint study.
	16	Reid (2002)	book review	Marketing-related motives in mergers & acquisitions: the perspective of the U.S. food industry	Find evidence that the brand equity related to corporate brands is often decreased as a result of M&A activities and individuals react differently to mergers employing different redeployment strategies.
	17	Jaju, Joiner and Reddy (2006)	experimental	Consumer evaluations of corporate brand redeployments	

Table 3-4 M&A Research in Top 10 Marketing Journals (Page 4)

Journal	No	Article	Method	Focus of the Study	Findings and how the article relates to M&As
Journal of Retailing	18	Kumar, Kerin and Pereira (1991)	quantitative (secondary data)	Examines a variety of finance, marketing and corporate related variables that are the likely antecedent conditions for M&A activities in retailing.	The results indicate that preconditions for M&A activity can be identified and the probability of becoming a bidder and target retailer can be determined on the basis of these variables.
Industrial Marketing Management	19	Weber and Dholakia (2000)	methodological and illustration	Propose a method to include marketing synergy in acquisition analysis	This article reviews an empirically tested step-wise approach for identifying, valuing, and realizing opportunities for marketing synergy related to proposed or consummated acquisitions. The approach focuses upon analyzing marketing consolidations in strategically driven, complementary mergers and acquisitions.
	20	Anderson, Havila and Salmi (2001)	conceptual and case	The importance of Customer and supplier relationships in acquisitions	Mergers and acquisitions have important implications, either positive or negative, for the merged companies' customer and supplier relationships. Effects of M&A vary in accordance with the connectedness that prevails between the companies before the merger. The connected mergers are more likely to be affected than unconnected ones.
	21	Palmatier, Miao and Fang (2006)	conceptual and case	Sales channel integration after mergers and acquisitions	The authors develop a methodological approach that uses a balanced-scorecard framework to guide managers through the sales channel integration process, and then apply this approach to a case. The results support the premise that channel integration can be improved by accounting for factors unique to the M&A context and using an approach that triangulates multiple perspectives.
	22	Richey, Kiessling, Tokman and Dalela (2007)	conceptual and quantitative (survey data)	The importance of target firm's relationship marketing managers and the implicit agreements that have kept them with the target firm.	The results of this study convey that the joint activity of maintaining the implicit contracts and retaining the relationship marketing managers have a stabilizing and positive impact on the productivity of subordinate marketing employees. These employees are a key success factor that enables the target firm to function effectively after the acquisition.

Table 3-5 M&A Research in Top 10 Marketing Journals (Page 5)

Journal	No	Article	Method	Focus of the Study	Findings and how the article relates to M&As
	23	Oberg, Henneberg and Mouzas (2007)	case	Illustrate and analyse changes in managerial sense-making and networking activities following a merger or acquisition.	Found that following a merger or acquisition managers may need to adapt their previous network pictures in a radical way; these adaptations are, however, not always realized as shifts in network pictures and adjustments in networking activities by all the managers involved. The paper contributes to a clearer view on the conceptual interdependence of the constructs of network pictures and networking in multi-actor situations and thus it develops a network perspective on mergers and acquisitions.
	24	Sanchez-Peinado and Menguzzato-Boulard (2009)	quantitative (survey)	Adopt an integrative approach to study the determinants for entry mode choice between strategic alliance, internal development and acquisitions in corporate diversification	The authors found that strategic alliances play an important role in avoiding reprisals from firms establishing in concentrated sectors or to overcome entry barriers related to product differentiation for small, medium and large firms alike. However, firms still prefer acquisition when diversifying into a non-related industry. When firms need higher levels of diversification, internal development or acquisition are also used in stead of strategic alliance.
Journal of Advertising Research	25	Katz (1991)	survey	How major U.S. advertising agencies are coping with data overload	In spite of trying to use the latest technology and get training, most ads agencies still feel overloaded with data beyond their abilities to process. The connection to M&A is that greater amount of data become available due to the greater concentration of the industry.
	26	Laforet and Saunders (1999)	content analysis and interviews	Examine the rationale behind brand strategies	The paper tests a series of hypothesis for why firms adopt different brand strategies, and the results show that branding strategies are not only market driven. Two of the hypotheses are related to acquisition, but they are not supported.
International Journal of Research in Marketing	27	Chen and Zeng (2003)	quantitative (secondary data)	Test that Multinational enterprises choose acquisitions over startups to overcome reputation barriers abroad.	The results show that Japanese investors facing higher reputation barriers in the target industry are more inclined to acquire existing firms, whereas those spending more on advertising prior to an entry are more likely to start up new ventures.
Journal of Product Innovation Management	28	Mahajan, Rao and Srivastava (1994)	methodological example (survey data)	The authors present a methodology to determine the importance of brand equity in acquisition decisions	By capturing the idiosyncratic perceived importance of brand equity of every decision maker involved in acquisition decisions, the methodology enables members of a committee within a firm to understand and reconcile their differences in evaluating potential acquisitions.

3.3.1 Merger and acquisition process:

I classify the marketing literature on M&A based on various stages of M&A activity. These stages are illustrated in figure 3-6. An M&A deal starts from changes in a firm's endowment, either internal or external, such as lack of pipeline project, or the need to enter a new market. The firm's response is either to consider a M&A, or pursue some alternative strategies such as alliance, or direct investment in the new geographic area to set up its own shop. If the firm decides to choose M&A, it will proceed to pick its M&A partner (with certain criteria). Once the mutual agreements are reached, a news announcement is made, and its effect on the stock market can be measured using event study method. After the announcement comes the lengthy period of integration process during which the two firms try to become one. In the long run the success of the deal can be measured. Although most papers cover only a part of the picture, an aggregation of the research gives a complete view across the entire M&A event.

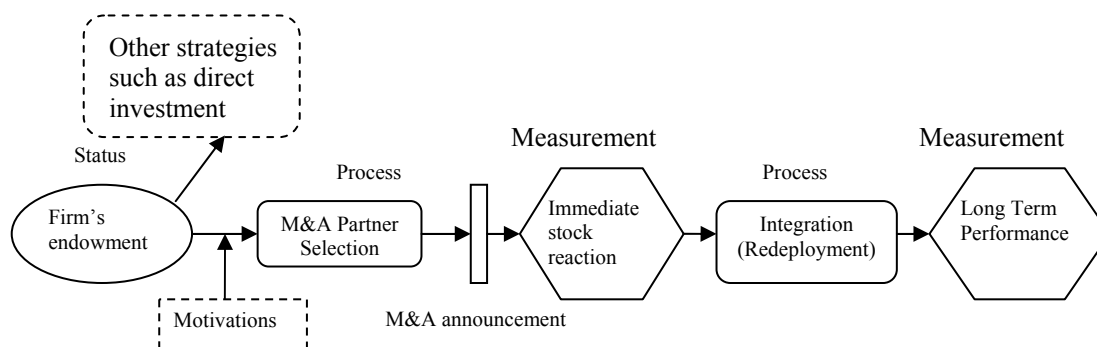


Figure 3-6 M&A Timeline

3.3.1.1 Endowment

Firm's endowment reflects the external or internal conditions of the firm (often the acquiring firm) before the M&A decision is made. Certain industry environments can often trigger merger activities (Silk and Berndt 1993, Zhao 2009, Markovitch,

Stechel and Yeung 2005). The current endowment of a firm affects its motivation to use M&A rather than other form of strategic activities to achieve its goal, whether it is entering a new market (Hennart and Park 1993, Chen and Zeng 2003), bumping up the innovation potential of the firm (Zhao 2009), changing the company's social image (Papavasileious, Swain and Bhattacharya 2008), or obtaining certain exclusive resources (such as brands, sales forces, or marketing expertise) which are locked inside other firms. Differences in the initial endowments of the acquiring firms are also used to explain any difference in performance during the integration process or the eventual performance of the newly formed firm (Prabhu, Chandy and Ellis 2005, Bahadir, Bharadwaj and Srivastava 2008 Swaminathan, Murshed and Hulland 2008).

The key findings of the marketing literature on the relationship between endowment and M&A activity can be summarized into two broad categories:

- i. ***Initial endowment influences the acquisition decision***: Acquisition is used as method of international market entry when investors are of weak competitive advantage (Hennart and Park, 1993) or face high reputation barriers (Chen and Zeng, 2003). Acquisition is also used when companies diversify into unrelated business (Sanchez-Peinado and Menguzzato-Boulard 2009). Finally, less innovative firms are more likely to enter into acquisition in order to produce immediate improvement in the firm's product portfolio (Markovitch, Steckel and Yeung, 2005; Zhao, 2009).
- ii. ***Initial endowment influences the success of an acquisition***: For firms which engage in internal knowledge development, acquisition can be a tonic for innovation (Prabhu, Chandy and Ellis 2005). On the other hand, firms with high product capital (i.e., those with greater product development and support assets) make smarter acquisition decisions and perform better on long-term financial measures (Sorescu, Chandy and Prabhu 2007).

These findings suggest that M&A (especially acquisition) is often used as a strategic option because it is quick and requires less industry expertise (as compared to internal research or Greenfield investment). In the case of international market entry, acquiring a local firm also avoids some entry barriers. However, M&A also brings new challenges in the integration (or redeployment) process, which I will discuss later on. Prabhu, Chandy and Ellis (2005) and Sorescu, Chandy and Prabhu (2007) even suggest that the successfulness of M&A in certain aspects largely depends on the preparation of the firms before merger. However, since the analysis of the operating environment of the merging firms usually suggests that many M&As are reactions to difficulty, it might not be fair to judge their outcome by comparing the new firm's performance to the average performance in the industry.

The opportunities for potential research in the endowment area are plentiful. The existing studies show that firms undertaking M&A are often self-selected into merger and their actions are driven by certain purpose. These findings should not be overlooked by any M&A research; otherwise there is a danger that the resulting conclusions may be biased. However, appropriate measures of endowments are not easy to come by, especially the ones beyond financial measures, such as market, personnel and innovation related measures. I will stress the importance of proper measurement in a later section.

3.3.1.2 Motivation

The motivation part of the M&A process is important in its own right and has important implications for the measurement of M&A outcomes. Not all the theories reviewed earlier are equally relevant for the marketing field. The most commonly cited theories for M&A in the marketing literature are resource-based view of the firm (Capron and Hulland 1999, Homburg, Bucerius 2005, Hennart and Park 1993) and knowledge-based view of the firm (Prabhu, Chandy and Ellis 2005, Zhao 2009). In

addition, some of the intuitive economic theories are also mentioned, such as economy of scale, economy of scope (Silk and Berndt 1993), market power (Singh and Zhu 2008), etc. The main findings of the marketing literature on M&A motivation can be summarized into two broad categories:

- i. **Marketing related motivations:** Scale and scope economies are important for U.S. advertising agencies, therefore small or medium firms have incentive to consolidate (Silk and Berndt 1993). Brands and marketing factors serve as important acquisition rationale in food and retail industries (Reid and Dahlhoff 2002, Kumar, Kerin and Pereira 1991).
- ii. **Strategic motivations:** Improving company's innovativeness and product portfolio is an important reason for M&A, especially in innovation driven industries (Markovitch, Steckel and Yeung 2005, Zhao 2009 and Prabhu, Chandy and Ellis 2005). Whether the M&A is related (synergistic) or unrelated (diversifying) serves as an important mediator for effects of resource deployment (integration) and long term value creation (Bahadir, Bharadwaj and Srivastava 2008, Weber and Dholakia 2002, Swaminathan, Murshed and Hulland 2008)

The findings on marketing related motivations (Reid and Dahlhoff 2002) confirm the importance of marketing issues in M&A research and foreshadow the subsequent discussions on the importance of marketing resources integration and their contribution to M&A outcomes.

In spite of the emphasis given to M&A motivations in the theoretical literature, the existing empirical literature inadequately controls for motivation when studying M&A outcome. In fact very few studies differentiate the M&A outcomes by their initial motivation. One reason is that motivation is difficult to classify and measure, the other is that stated motivations are often not entirely reliable, since the managers may try to justify their choice ex-post. However, given the number of empirical

studies trying to classify merger motivation, I am convinced that difficulties in measurement can be overcome, and differences in motivation can be controlled for in M&A outcome studies.

3.3.1.3 Merger Partner Selection

Once the decision to do M&A is made, the next task is to choose a suitable target. This order of action is not strictly one way, since in some cases the acquisition decision is made after the target is identified. However, the acquirer still needs the implicit environment for M&A, and needs to decide in favor of using acquisition to achieve its strategic goals. Rao, Mahajan and Varaiya (1991) and Reid (2002) specifically listed the conditions an ideal target should satisfy and designed models to implement target selection. Kumar, Kerin and Pereira (1991) studied empirically the likely antecedent conditions for M&A activities and found marketing-related variables to be significant in predicting merger. My first essay empirically studies the drivers of target selection process with emphasis on synergy and similarity and complementarity measures of synergy.

The variables proposed as target selection criteria in these researches include: financial variables (total sales; sales growth; return on equity; debt/asset ratio; market/book ratio; insider share ownership), and marketing variables (product/market/distribution presence). The latter measurements are based on managers' expectations and judgments, which are detailed and comprehensive, but also suffer from subjective biases and difficulty in large scale implementation. Moreover, solid empirical tests are lacking to verify the practicality of these methods. It is not clear whether the criteria listed in the models are used in business decisions. Kumar, Kerin and Pereira (1991) led the attempts in this direction; the other two essays in my dissertation also aim at contributing to the understanding of M&A partner selection criteria. Also worth noting is that Zhao (2009) looks at the bidding

war among several potential acquirers and analyzes the factors that make the final winner stand out. It is a rare study which gives attention to the target's choice of acquirer (through market mechanism). The essay 2 in my dissertation highlights the mutual selection involved in M&A and uses a matching model to approximate the process.

3.3.1.4 Announcement

Once the merger partner is decided and the deal is announced to the media, the stock market will react to the news with either positive or negative stock price movement. Swaminathan, Murshed and Hullah (2008) use event study method to gauge the investors' reaction to M&A announcement and judge whether a deal is successful or not. The event study method is widely used in the finance literature on M&A because, under the efficient market hypothesis, the stock market reaction to M&A announcement reflects the change in expected future cash flow from the merger. It is less commonly used in the marketing literature on M&A since the focus is usually on market related measures.

3.3.1.5 Integration Process

Of course, expectations do not always turn into reality. The expected synergies can be delivered only if the integration process is successful. According to the resource based view of the firm, the purpose of M&A is to redeploy valuable resources (often in the form of intangibles) which are locked inside organizations and can only be acquired through merger or acquisition. Therefore the redeployment of these resources after merger becomes essential. A number of papers in marketing discuss the issue of redeployment in detail. The findings can be summarized into two broad categories:

- i. ***Type and direction of redeployment:*** Highly immobile resources (brands and sales force) are more likely than less immobile resources (general marketing expertise)

to be redeployed. Furthermore, resources tend to be redeployed from the acquirer to the target more often than in the reverse direction (Capron and Hulland 2008).

- ii. ***Impact of redeployment***: Marketing resource redeployments have minimum effect on cost-based synergies, but a positive impact on revenue-based synergies (Capron and Hulland 2008). Market-related performance after M&A has a much stronger impact on financial performance than does cost savings. In addition, the extent of integration is beneficial in terms of cost savings but detrimental in terms of market-related performance (Homburg and Bucerius, 2005).

These findings overwhelmingly suggest that marketing integration matters for the realization of M&A goals and reveal the direction of resource movement between the acquirer and the target. However, these studies are based on the “acquirer” or “two firm” centric view, and do not discuss the effect of M&A on the other parties related to the merging firms. In reality, many of the “intangible assets” of the merging firms are based on certain assumptions towards the other players in the network, such as suppliers, channel partners, or customers of the two firms. For such analysis, a network based approach is better suited (Oberg, Henneberg and Mouzas 2007) as illustrated below.

Analysis of the merging firms’ network includes studying the reactions of channel partners (Palmatier, Miao and Fang 2006), suppliers (Anderson, Havila and Salmi 2001), customers (through their reactions to firm’s branding strategies) (Jaju, Joiner and Reddy 2006, Laforet and Saunders 1999), competitors (Katz 1991), and overall network interactions (Oberg, Henneberg and Mouzas 2007). Richey, Kiessling, Tokman and Dalela (2007) also discuss the importance of marketing managers since they are in charge of many business connections of the firm. Papavasileiou, Swain and Bhattacharya (2008) and Papavasileiou (2009) study the consumers’ reactions to

M&A not through their recognition of brands, but directly towards the image of the merged firm.

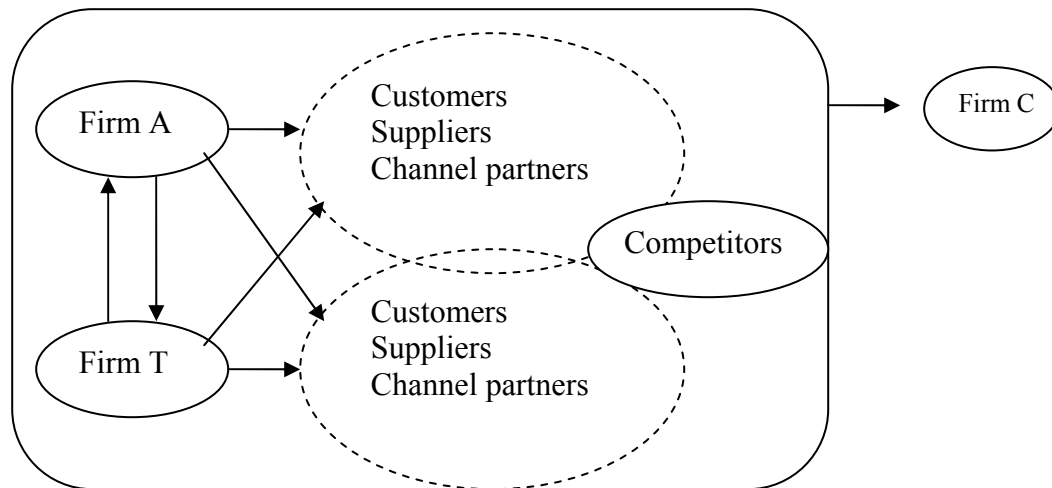


Figure 3-7 M&A under Resource Based View of Firm

The major findings on integration research can be classified into three broad categories:

- i. ***Impact on channels and marketing managers:*** Channel integration can be improved by accounting for factors unique to the M&A context and using an approach that triangulates multiple perspectives (Palmatier, Miao and Fang 2006). The joint activity of maintaining the implicit contracts and retaining the relationship marketing managers have a stabilizing and positive impact on the productivity of subordinate marketing employees. These employees are a key success factor that enables the target firm to function effectively after the acquisition (Richey, Kiessling, Tokmand and Dalela 2007)
- ii. ***Impact on consumers:*** Brand equity related to corporate brands is often decreased as a result of M&A activities and individuals react differently to mergers employing different redeployment strategies (Jaju, Joiner and Reddy, 2006). The matching between two corporate images as well as the naming strategy (combined

vs. separate) affect consumer's perceptions of M&As. Choosing the less favorable naming strategy may harm both consumers' attitudes and purchase intentions (Papavasileiou 2009). The impact of acquisition on consumer-company identification for Socially Responsible Companies is a function of three factors: the CSR profiles of the acquiring and acquired companies; consumers' attributions regarding the companies' CSR policies, and consumers' Social Value Orientation. (Papavasileiou, Swain, and Bhattacharya 2008)

- iii. ***Impact on suppliers:*** Mergers and acquisitions have important implications, either positive or negative, for the merged companies' customer and supplier relationships. Effects of M&A vary in accordance with the connectedness that prevails between the companies before the merger. The connected mergers are more likely to be affected than unconnected ones (Anderson, Havila and Salmi 2001).
- iv. ***Impact on the network as a whole:*** Business relationships are intangible assets that might be part of the acquisition motivation, yet the transfer of these relationships can not be taken for granted. Without careful management, acquisition can have unexpected effects on these relationships (Anderson, Havila and Salmi 2001, Oberg, Henneberg and Mouzas 2007).

These findings serve as a reminder that M&A is not simply a transaction between the two firms. The network relationship needs careful management; otherwise the “intangible assets” which motivate the M&A may lose their value as network partners adjust their behavior differently from the expectations of the merged firms. These studies also demonstrate the lengthy and complex nature of the integration process, which unless managed properly can significantly affect the M&A outcome. Relatively speaking, the internal affairs of the merged firm (such as consolidating production facilities to realize cost synergies, redeploying resources between acquirer

and target, keeping talent from leaving the firm, resolving personnel issues etc.) are easier to control during the integration process than its external affairs (such as consumers' and channel partners' expectations). Since marketing mainly involves nurturing firm resources dependent on external relationships, the network approach becomes truly important for researchers and managers alike. Moreover, as Anderson and Naru (1990) and Katz (1991) suggest, a merger between two companies in an industry may lead to a change in the overall landscape, which requires that the marketing managers be well aware of the larger environment and the implications of competitors' actions in real time.

Although the network approach towards M&A deserves the attention and focus of researchers, one challenge in undertaking such research is that business network interactions are difficult to model and empirically measure. So far most studies in this area have relied on surveys, interviews and case studies. It would be ideal if modeling and empirical analyses are further introduced into this area of research.

3.3.1.6 Outcomes

Lastly, I review the outcome of mergers. Although the interest of many M&A researches, M&A outcome is seldom discussed in isolation. Instead, it is analyzed in relation to the M&A variables I mentioned before, such as the environment or the endowments of the firms before merger, or the integration process. Since I have already discussed these topics in the prior sections, I will focus on the measures used for M&A outcome in this section.

The marketing literature on M&A seems to focus on the use of long term performance measures, such as long term financial returns (Sorescu, Chandy and Prabhu 2007), market share and profitability (Capron and Hulland 1999, Homburg and Bucerius 2005), and innovation performance (Prabhu, Chandy and Ellis 2005, Zhao 2009) which is in contrast to the finance literature's preference for using short-term

performance measures such as event window stock returns. This is because marketing studies focus on the economic value of M&A as measured by the improvement in certain areas of firm performance, rather than stock market's expectations of synergies from a merger. The common shortcoming of the performance measures used in much of past research is that the unit of analysis is often the acquirer firm only, which doesn't take into account the synergies and resources contributed by the target to the combined firm. Depending on the size and resource richness of the target, the impact of M&A on firm performance will differ across deals. Therefore it is better to use the combination of acquirer and target as the unit of analysis to measure the outcome of merger.

3.4: CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

Through the review of M&A theories and marketing research on M&A, I reach the following conclusions:

1. M&A is a topic that links marketing with many other disciplines such as economics, strategy, finance, law and human resource management. Those fields of study can provide valuable theoretical foundations for marketing studies in M&A.
2. Marketing specific reasons such as brands, products, markets and consumers are important motivations for undertaking M&A, which highlights the importance of scholarly marketing research on this topic.
3. Marketing scholars have demonstrated that redeployment of marketing resources (including brands, sales force, and general marketing expertise) have a significant impact on the outcome of M&A.
4. The "intangible resources" which acquirers aim to acquire from M&A cannot simply be transferred the same way as physical resources, since they often involve other parties such as suppliers, retailers and consumers. Inappropriate management of

network of relationships with these external parties (or simply failure to expect their reactions) can negatively impact the new company's image and reduce or eliminate the expected synergies from the deal.

The gaps in the current research and suggestions for future marketing research in this area are summarized below:

1. The current research often focuses on the acquirer firm, and seldom on the target. For example, the studies on M&A partner selection take the position of acquirer, and assume that the chosen target will always agree. This is not always the case as shown through bidding wars by Zhao (2009). The acquirer centric view is also reflected in the empirical measurements used in the literature. Many studies use only the acquirer's performance measures, totally disregarding the fact that the target also contributes to the combined firm's performance.

2. The existing literature does not always control for the underlying motivation for M&A when drawing conclusions about the outcome of a deal. This is especially relevant for studies in which outcome is measured on a subset of firm performance. If the motivation for an M&A deal is to improve an area of firm performance which is not measured by a study, then the conclusions of that study may not be justified.

3. While studying the motivations of M&A, special attention is needed towards management hubris, as suggested by the financial theories of M&A. Beyond the stated incentives revealed at press release, which is often biased by the executives' incentive to justify the transaction, some objective measures should be used to classify the M&A motivation (as in the essay 1 of this dissertation).

4. The network approach towards M&A studies is an important and valuable research paradigm. Future modeling effort and empirical analysis in this area is desirable to supplement the survey, interview and case based studies.

5. According to the endowment studies of M&A, many firms initiate M&A as a reaction to internal or external changes. If the firms involved in M&A are systematically different from their industry peers, their post-merger performances should not simply be compared to the industry average (or even its own performance a few years ago), since a decline in performance might still be better than what would happen if the merger did not happen at all. Ideally a group of firms that were facing similar conditions as the pre-merger firms should be selected to serve as the control group.

6. Besides M&A, Hennart and Park (1993) and Chen and Zeng (2003) point out other forms of strategic moves as methods to enter new markets, which link the M&A research to other marketing studies on alliances (such as Bucklin and Sengupta 1993). There have been studies on the differences and relationship between M&A and alliance in other academic fields (e.g., Wang and Zajac 2007; Yin and Shanley 2008), while such studies are rare in marketing literature.

7. The innovation focused research in M&A (Prabhu, Chandy and Ellis 2005, Zhao 2009) also suggests possible linkage to the R&D and product innovation areas of research in marketing. Innovation is an important and fruitful area of research; however appropriate measurements of innovation outcomes are hard to come by. The difficulty in measurement might explain why much innovation related research focuses on one or a few industries (because within an industry or similar industries, uniform measurements of innovation are easier to find). Nevertheless, new measurement of innovation might lead to unprecedented findings.

8. M&A serves as a perfect topic at the intersection between marketing and finance, as a response to the call for more research across these two fields (Srivastva, Shervani and Fahey 1998; Hanssens, Rust and Srivastava 2009). Selected finance measures (such as stock market valuation, internal rate of return) can be adapted to

capture the impact of marketing changes due to M&A; marketing measures (such as customer satisfaction, product return rate) can also be linked to firm's financial performance under the impact of M&A.

In summary, M&A is a promising yet under-developed area of research in marketing. It presents both opportunities and challenges as an interdisciplinary topic of research. I hope more marketing scholars would find interest in this topic and contribute to people's understanding in this area.

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