경영학석사 학위논문

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- An Empirical Analysis -

## 빅테크 인수합병의 수익률에 대한 실증 분석

2022 년 7 월

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# Abstract

## Value Creation in Big Tech Acquisitions

## - An Empirical Analysis -

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The information technology industry undergoes business model shifts in which the competitive landscape is shaped by major Big Tech companies. Computer hardware, software, and related service firms are increasingly engaging in various diversification strategies to achieve a full-fledged ecosystem led by innovative software. This paper examines the effects of the acquirer's wealth of tech giants involved in 749 transactions between 1984 and 2020. The empirical results show that the synergy effects enjoyed by the acquirer around the M&A announcement yield positive returns for Big Tech companies' horizontal expansion of acquiring software targets. The short-term yields are not positive for Big Tech companies' vertical expansion of acquiring software targets. The findings have important implications on the dynamics of the IT industry competition fueled by tech giants.

**Keywords:** Big Tech, corporate mergers and acquisitions, synergy effect, abnormal stock returns, event study

**Student number:** 2020-21664

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# Chapter 1. Introduction

The information technology industry is reinventing the business model to increase the share of revenue from IT convergence, subscription service, and digital transformation. Tech giants occupy the forefront of these ventures. A common strategy of major tech giants is to expand their line of products by providing software add-ons to their existing technology stack with in-house R&D spending or acquisition costs.[1] Cisco has made several high-profile acquisitions of software targets to serve various markets in networking and security. In 2017, Cisco acquired Viptela for $610 million to enhance its SD-WAN portfolio.[2] The same year, the company acquired AppDynamics, a leading firm in application performance management as well as ThousandEyes, which occupied a unique niche in cloud network performance monitoring.[3] In 2018, Cisco completed the acquisition of Duo Security, which offers unified-access security and multifactor authentication delivered through cloud infrastructure.[4] Customers are guaranteed the complete user experience that comes with a level of quality that is difficult to imitate.

Software companies as well as hardware companies are undergoing business-model transitions from perpetual license models to software as a service (SaaS) or SaaS-like recurring-revenue models.[5] The most well-known example is Adobe which transitioned its revenue channel from software licensing to subscription. Hewlett Packard Enterprise, a traditional computer hardware provider, offers Greenlake Edge-to-Cloud Platform solution,

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[1] https://www.hpe.com/us/en/insights/articles/consumption-based-it-a-primer-for-your-business-1711.html
[2] https://economictimes.indiatimes.com/small-biz/startups/cisco-to-acquire-indian-origin-ceo-led-firm-viptela-for-610-million/articleshow/58501675.cms
[3] https://www.forbes.com/sites/patrickmoorhead/2021/08/04/the-rise-of-full-stack-observability-and-ciscos-strategy-to-fulfill-it/?sh=7ff9a1436abd
[4] https://newsroom.cisco.com/press-release-content?articleId=1945408
[5] https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/hardwares-business-model-shift-finding-a-new-path-forward

which is a bundle of traditional computing and storage hardware with software products and services that is priced using a consumption-based pricing system.[6] The on-premises data centers deliver scalable hardware with which corporate customers can create and destroy VMs impromptu or scale storage requirements up and down, paying only for the resources they use.[7]

Since the trend of information technology changes at a rapid pace, Big Tech companies are always on the lookout for the latest technologies, venturing into different industries that are undergoing digital transformation with the advent of innovative technologies. In 2021, Microsoft announced that it would buy Nuance Communications, a provider of artificial intelligence and speech-recognition software, for over $16 billion, as it pushes to expand its health care technology services.[8] The same year, IBM acquired 7Summits as a broader investment strategy in services and ecosystem partnerships to push toward digital transformation through hybrid cloud and AI that is applicable in intelligent business workflows.[9] Like this, Big Tech firms such as Microsoft, Cisco, and Hewlett Packard show distinct trajectories of growth that allow them to compete and prosper, shaping the trends and patterns of IT strategy. The competition of the IT industry, especially among tech giants is intense. They are constantly challenged by new entrants such as unicorn companies and strive to protect and increase the market share from other prominent players such as existing tech giants.

The software industry appeals to investors because of the inherent scalability and

[6] https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/hardwares-business-model-shift-finding-a-new-path-forward
[7] https://www.hpe.com/us/en/insights/articles/consumption-based-it-a-primer-for-your-business-1711.html
[8] https://www.nytimes.com/2021/04/12/business/microsoft-nuance-artificial-intelligence.html
[9] https://www.prnewswire.com/news-releases/ibm-acquires-7summits-to-drive-digital-transformations-for-salesforce-clients-301205531.html

profit margins from the low marginal costs of selling incremental units of a software product, oftentimes lavishing investors with high earnings multiples.[10] Investments pour into software products and services from venture capitalists because with the promise of quick growth and high profit margins.[11] Industrial firms came to a collective realization that they can "go digital or go extinct", which has set the precedent of an arms race for software acquisitions in the tech industry.[12] For this reason, Big Tech companies constantly update their software stack and look for new market opportunities in order to not only survive and thrive in the competition, but also to appeal to external investors.

"To build or buy" is a classic strategic conundrum for firms, and when it comes to an area that is as far outside the company's core competency such as cloud computing or mobile software development, buying rather than building the technology is often the chosen move.[13] Traditionally, mergers and acquisitions lead to an extension of markets, and a surge of financial, technological, and operational capital for the acquirer. For tech M&As, specifically, companies benefit from the fast ownership of state-of-the-art software technologies and access to an established customer base.[14] The upward trend in global M&A continues, reaching a record $3.9 trillion in deals by September of 2021, with the tech sector taking up 21% of all M&A activity.[15] Well-planned acquisition strategies have helped tech giants to come out on top in the hyperconnected industrial world led by innovative software. Tech giants that started out in hardware manufacturing (e.g., Hewlett Packard, Cisco, etc.) have

[10] https://www.forbes.com/sites/forbestechcouncil/2020/01/28/the-arms-race-of-industrial-companies-buying-software-companies/?sh=3b601a7715b9
[11] https://www.ft.com/content/6b897afa-33ce-11e2-9ce7-00144feabdc0
[12] https://www.forbes.com/sites/forbestechcouncil/2020/01/28/the-arms-race-of-industrial-companies-buying-software-companies/?sh=7b03491b15b9
[13] https://www.forbes.com/sites/forbestechcouncil/2020/01/28/the-arms-race-of-industrial-companies-buying-software-companies/?sh=7b03491b15b9
[14] https://news.bloomberglaw.com/daily-labor-report/tech-m-a-is-thriving-but-watch-regulatory-headwinds
[15] https://news.bloomberglaw.com/daily-labor-report/tech-m-a-is-thriving-but-watch-regulatory-headwinds

built up an increasingly complex skill stack by branching out into data science and security. With the ruthless expansion of Big Tech, a full-fledged ecosystem is now a requirement.

While the strategic moves of major tech companies have long shaped the competitive dynamics of the IT industry, the value creation mechanisms of Big Tech M&As have been the least studied of all corporate functions in M&A. Thus, the research question of this paper is raised by the trajectory of Big Tech firms, both in the hardware and software sectors, to heavily engage in merger and acquisition transactions. Are acquisitions of software targets beneficial to the acquiring tech giants' shareholders? Do acquisitions of software firms bring different returns for software versus hardware tech giants when the deal is announced? The purpose of this study is to test whether tech giants in the software sector (Adobe, Microsoft, Oracle) and tech giants in the hardware sector (Hewlett Packard, IBM, Cisco Systems) yield positive abnormal returns from acquiring software targets in the U.S. M&A market.

This paper starts off with an overview of the related literature in chapter 2. I introduce a set of hypotheses that will be tested empirically. This is followed by chapter 3 in which I present the data, criteria, methodology, and sample analyses. The empirical results are presented in chapter 4, and a discussion of major findings as well as limitations and contributions of the paper are followed in chapter 5.

# Chapter 2. Literature Review and Hypotheses

## IT Industry Acquisitions

Many event studies measure the success of M&A transactions by analyzing the abnormal returns for acquirers' and targets' stock prices around the announcement day. The difference between the observed and normal returns is known as abnormal returns. Event studies are conducted based on the market model and the cumulated abnormal returns (CARs) are calculated as a success metric to measure the short-run effects of the event. CARs are viewed as a firm-level metric, since they reflect the investor's expectations for the acquisition announcement on the performance of the combined firm. CARs are also a transaction-level metric, since the time span used to capture the stock price variations is sufficiently small that it rules outother events of the merging two companies that is not connected to the announcement deal (Zollo and Meier 2008).

One of the most fundamental motives for M&As is the synergy effect. M&As allow corporations to gain through economies of scope and scale, cost reductions, increased market power, and reduced earnings volatility (Seth, Song, and Pettit 2002). Past literature show that most of the synergy effects go to the target. The abnormal returns for the target firms tend to be significant and positive, whereas abnormal returns for acquiring firms are lower or not significant (Jensen and Ruback 1983). Tables 1 summarizes existing literature of M&A analyses that have important implications about the IT industry. The theoretical grounds in these studies for the creation of M&A synergies involve the existence of network externalities. Table 2 summarizes prior M&A literature on the antecedents of success to the acquirer with deal-specific situational variables that are operationalized by the researchers. Some of these variables include unique IT-related properties of the acquirer.

For the software industry-specific studies in Table 1, consistent with existing studies on mergers and acquisitions, the number of examined success measures is low. While the targets' success is mostly positive, the success of acquirers is subject to debate. In fact, according to a meta-analyses of post-acquisition performance, both market return measures such as CARs and accounting returns such as ROA, ROE, and ROS indicate that expected synergies from the day of a merger announcement are not subsequently realized by acquiring firms (King et al. 2004). King et al. (2004) extend these analyses to imply that a stronger argument can be made that firms' M&As have a modest negative effect on the long-term financial performance of acquiring firms. Thus, it remains unclear whether buyers in the software industry can realize the expected value of takeovers (Schief, Buxmann, and Schiereck 2013).

A significant finding in the M&A literature in the IS discipline is the work of Uhlenbruck, Hitt, and Semadeni (2006) that serves as a rebuttal to existing literature that predominantly conclude that acquirer returns are not positive in acquisitions. They operationalize the target group as online firms and empirically show that the acquisition of online firms by both online and offline firms in the information technology industry brings positive abnormal returns to the acquiring firm around the announcement day (Uhlenbruck, Hitt, and Semadeni 2006). Chang and Cho (2017) examine the underlying motives of IT firms that enter into M&A deals. Those that seek to improve their production efficiency by acquiring production-related assets of the target firm are categorized as having a production-side motive (Chang and Cho 2017). Those that seek to capture value from the target's customers are categorized as having a customer-side motive (Chang and Cho 2017). Software industry acquisitions with customer-side intent, aiming to benefit from consolidated customer networks, gain the acquirer higher returns as well as risks (Chang and Cho 2017).

Gao and Iyer (2006) empirically prove that synergies arise from M&As that expand the technology architecture (service, software, and hardware layers) due to the benefits gained from indirect network effects. While most companies specialize in one of the layers, when they acquire assets in other layers, they are able to gain synergistic effects (Gao and Iyer 2006). Interestingly, acquisitions that target same layer assets do not lead to positive abnormal returns, which further support the theory of complementarities that are widely accepted as a framework for corporate diversification (Gao and Iyer 2006).

Tables 2 implies that the success factors of mergers and acquisitions are generally inconclusive, which calls for studies to be conducted in diverse M&A settings. For instance, Hossain, Pham, and Islam (2021) attribute the cause of varying abnormal returns to the unique properties of the acquirer. They categorize certain acquirers as serial acquirers (i.e., a firm that announces at least two M&A deals in 24 months), and find that serial acquirers yield lower stock returns, but higher risk compared to single acquirers (Hossain, Pham, and Islam 2021). Moreover, the application of foundational theories such as the resource-based view of the firm as well as the introduction of new variables such as cross-business IT integration (CBITI) capability (Tanriverdi and Uysal 2011) expand the horizon of the M&A research. Tanriverdi and Uysal (2011) empirically show that in short-run value creation, capital markets are indifferent to whether the value is created out of synergies in similar resources of related targets or complementary resources of unrelated targets. On the other hand, in long-run value creation, acquirers with superior CBITI can integrate the complementary resources of unrelated targets, create unique synergies that are difficult to replicate, and achieve superior operational performance (Tanriverdi and Uysal 2011).

While the scope of analyses ranges from all industries to only the tech industry in earlier M&A studies, there are some key differences between this study and previous work.

First, I narrow the acquiring firm to include Big Tech firms that have significant market dominance in either software or hardware sectors. Second, I craft the operational definition of the target as a software business. Third, I explicitly compare the yields of software sector tech giants and hardware sector tech giants upon acquiring the target software business. The research gap from the literature review reveals that in an empirical setting, IS research has yet to sufficiently study the various diversification strategies of well-established IT sector giants. When it comes to acquisitions, Big Tech companies make more frequent and larger scale bids than other IT firms. The M&A literature in IS has not yet empirically validated how software firm acquisitions create value for different types of acquirers in the IT industry, namely tech giants with resources based in software and tech giants with resources based in hardware.

**Table 1. IT industry M&A studies**

| **References** | | | **Chang and Cho 2017** | **Gao and Iyer 2006** | **Uhlenbruck et al. 2006** |
|---|---|---|---|---|---|
| Industry | | | Information technology | Information technology | Information technology |
| Data and method | Timeframe | | 1996-2010 | 1999-2004 | 1995-2001 |
| | Number of M&As | | 1,227 | 193 | 1,029 |
| | Success measure | | BHAR volatility | CAR | Abnormal returns |
| Properties of transaction | Payment type | Cash | negative | | n.s. |
| | | Stock | n.s. | | n.s. |
| | | Both | | | |
| | Age | Low | | | |

| | | | | | |
|---|---|---|---|---|---|
| Properties of acquirer | | High | negative | | |
| | Number of Employees | Low | | | |
| | | High | | | |
| | M&A experience | Low | | | |
| | | High | negative | | negative |
| Properties of target | Form of organization | Public | n.s. | | |
| | | Private | n.s. | | n.s. |
| | | Subsidiary | | | |
| Key findings | Intent | Customer side | positive | | |
| | | Product side | negative | | |
| | Software stack layers | Same stack | | negative | |
| | | Adjacent stack | | positive | |
| | | Detached stack | | negative | |
| | Acquisition of internet firms | Online - online | | | positive |
| | | Offline - online | | | positive |

Only significant effects are reported in quantitative studies. The abbreviation “n.s” denotes non-significant results.

**Table 2. M&A success determinants**

| **References** | | | **King et al. 2004** | **Tanriverdi and Uysal 2011** | **Hossain et al. 2021** |
|---|---|---|---|---|---|
| Industry | | | All industry | All industry | All industry |
| Data and method | Timeframe | | 1921-2002 | 1999-2001 | 2000-2016 |
| | Number of M&As | | 93 | 141 | 2,696 |
| | Success measure | | Abnormal returns | CAR | CAR |
| Properties of transaction | Payment type | Cash | n.s. | negative | n.s. |
| | | Stock | | | |
| | | Both | | | |
| Properties of acquirer | Age | Low | | | |
| | | High | | | |
| | Number of Employees | Low | | | n.s. |
| | | High | | | |
| | M&A experience | Low | | | |
| | | High | n.s. | n.s. | |
| Properties of target | Form of organization | Public | | | |
| | | Private | | | positive |
| | | Subsidiary | | | |

| | | | | | |
|---|---|---|---|---|---|
| Key findings | Return and risk of serial acquisitions | Serial acquisition return | | | negative |
| | | Serial acquisition risk | | | positive |
| | Strategic fit | Focus | n.s. | | |
| | | Diversification | n.s. | | |
| | Cross-business IT integration capability | Low | | | |
| | | High | | positive | |

Only significant effects are reported in quantitative studies. The abbreviation “n.s” denotes non-significant results.

## The Characteristics of the Software Markets

Firms make decisions upon the assets and resources they own and the kind of labor and activities they can employ (Gawer 2020). A prominent method in which firms develop new assets is either through internal R&D or mergers and acquisitions. In the IT industry, technological changes happen rapidly, so it makes sense for Big Tech to constantly acquire new technologies from start-ups to manage the risk of technology becoming obsolete.

Companies that specialize in software supply goods and services that interact with complementary products made by other businesses to produce business value (Gao and Iyer 2006). This distinctive characteristic that the software market has that can be singled out from the industrial market is the existence of network effects (Gallaugher and Wang 2002). The ability to create network effects to expand market share and product complementarity is arguably the most important ability for ICT firms to have to ensure their survival. Effectively managing network properties is the reason why some firms thrive, while others perish (Zhu and Iansiti 2012). Teece et al. (1994) propose that firm's boundaries can be characterized in terms of learning, path dependencies, technological opportunities, selection environment, and complementary assets. The existence of complementary assets helps contour evolutionary paths, and these paths help determine the composition of a firm's portfolio of complementary assets (Teece 1986).

Network-based competition can be distinguished into two types of network effects – customer network effects and indirect network effects (Gao and Iyer 2006). Customer network effects are the demand-side economies of scale that come with the degree of adoption by customers. Chang and Cho (2017) empirically show that software industry acquisitions with customer-side intent, aiming to benefit from consolidated customer networks, gain the acquirer higher returns as well as risks. Indirect network effects are the

economies of fitness or strategic complementary that come with the availability of supporting software modules. Modular hardware, software, and communications technologies make it simple to design and reconfigure IT infrastructures to match the unique requirements of various businesses (Tanriverdi 2006). Gao and Iyer (2006) empirically prove that synergies arise from M&As that expand the technology architecture (service, software, and hardware layers) due to the benefits of indirect network effects. While most companies specialize in one of the layers, when they acquire assets in other layers, they are able to gain synergistic effects. Thus, tech giants with core technological strengths (e.g., proprietary technology) in either software or hardware may yield positive returns for their investors from the acquisitions of software business targets. The potential strategic benefits to acquisition of software firms by Big Tech suggest the following hypotheses:

*Hypothesis 1. Big Tech company's horizontal acquisition of software target results in positive abnormal returns for the acquirer.*

*Hypothesis 2. Big Tech company's vertical acquisition of software target results in positive abnormal returns for the acquirer.*

## IT Resources and Management Practices as a Source of Synergy

While acquisitions generally have been demonstrated to lead to the creation of economic value, the underlying reasons behind this value creation stem from varying sources and to varying degrees. Bititci et al. (2007) attribute four sources of synergy that collaborative enterprises can expect from combining their business functions: strategic synergy, operational synergy, cultural synergy, and commercial synergy. Software sector tech giants and hardware sector tech giants have recognizable differences in the internal processes and

value chain. The key business processes of an enterprise include generating demand, developing products and services, fulfilling orders, supporting aftersales, etc. These processes enable the management to oversee the performance of the internal business and support processes in line with the strategic objectives of the business (Bititci et al. 2007). Brush (1996) finds empirical evidence for net gains in post-acquisition shareholder wealth that stem from operational synergies. Gupta and Gerchak (2002) further develop these findings by quantifying the instances that increase or lower the value of operational synergy. If the acquirer and target operate in independent businesses, the differences in production facilities lead to an increase in the acquirer's demand (Gupta and Gerchak 2002). The target, resultingly, become less attractive which lower the value of operational synergy (Gupta and Gerchak 2002). This discovery provides an explanation for a higher likelihood of success from horizontal collaboration between a software sector bidder and a software sector target in M&As.

The cultural differences between physical product manufacturing and software development also pose a challenge for hardware companies attempting to buy software companies and vice versa. Hardware involves various phases from ideation using computer drafting tools, prototypes to mass production. When a problem arises, the entire development process has to be repeated, which alludes to investment gestation lags. Software development, on the other hand, incorporates short development cycles and feature-driven development such as agile methods. In fact, one of the most commonly mentioned causes for merger and acquisition failure is cultural incompatibility (Nguyen and Kleiner 2003, Lodorfos and Boateng 2006). The profound impact of a firm's culture can be seen in all organizational practices, directives, administrative processes, and leadership styles (Chatterjee et al. 1992). Prior M&A research alludes to the importance of compatibility of the merging companies'

top management cultures in creating shareholder value. For instance, Teerikangas and Very (2006) empirically validate the negative effects on sociocultural integration, synergy realization, and shareholder value rooted in cultural differences. Bauer and Matzler (2014) find empirical evidence that a high cultural fit in the premerger phase of the acquisition lead to a higher degree of integration as well as M&A success.

Gupta (2011) calls attention to the two types of organizational culture present in firms: prospectors and defenders. Prospectors are highly proactive and innovative, operating on flexibility and effectiveness while defenders are much less proactive and need stability and efficiency (Reeve 1994). The emphasis on low cost by the defenders necessitates close attention to operational details, such as the relentless pursuit of cost savings and productivity gains through standardization of components and processes, procedure routinization, and the integration of functional activities across business units (Walker Jr and Ruekert 1987). Bititci et al. (2007) suggest that the level of compatibility of operational culture and behavior between partner organizations affects management responsiveness, risk sharing, systems sharing, and information sharing. Hardware tech giants such as Cisco and IBM have the foundations as manufacturing firms before they set out to become global IT innovators. Computer hardware manufacturing values frugality, attention to detail, and discipline to maximize cost efficiency and quality. On the other hand, software manufacturers such as Microsoft and Oracle with the workforce consisted largely of software engineers and tech leads, foster risk-taking, individuality, and innovation. Therefore, when tech giants acquire software businesses, acquirers that have foundations as a similar software manufacturer will assimilate the new organization more effectively based on having compatible operational culture. Hardware sector tech giants, with their long history and practices, will likely show more rigidity reaching high levels of integration with software targets due to the compatible

alignment in operation and culture at the organizational level. This line of logic leads to the final hypothesis:

> *Hypothesis 3. Big Tech company's vertical acquisition of software target results in lower abnormal returns than horizontal acquisition of software target.*

# Chapter 3. Method

This paper investigates mergers and acquisitions undertaken by tech giants listed on the U.S. stock exchange that are officially announced between 1984 and 2020. Tech giants were chosen based on the dominance to affect the competitive landscape of the market through expansion, indicated by acquisition frequency. The acquirers are further classified by the operating model (e.g., supply chain, manufacturing organizations, etc.) of the business, specified by the market sectors they originate in. Thus, the analysis is narrowed down to IT industry tech giants in the software sector and hardware sector that have announced at least two M&A transactions, and the time between deals is less than 24 months. According to these criteria, six leading IT companies that have engaged in the most active mergers and acquisitions in the chosen time span are chosen as the data sample. The acquirers are further grouped in two based on the Standard Industrial Classification (SIC) code, which assigns firms based on common characteristics shared in not only the products and services, but also the operational resources of a business such as production and delivery system.

The acquirers that are categorized into software sector tech giants, Adobe Incorporated, Microsoft Corporation, and Oracle Corporation, have SIC code of 737 which is described as computer programming, data processing, and other computer-related services. The acquirers that are categorized into hardware sector tech giants, Hewlett Packard Corporation, IBM Corporation, and Cisco Systems Incorporated, have SIC code of 357 which is described as computer and office equipment. The acquisition target firms are those with SIC code of 737 which encompasses computer programming services (7371), prepackaged software (7372), computer integrated systems design (7373), computer processing and data preparation and processing services (7374), and information retrieval

services (7375). The transaction sample and deal-specific data are directly drawn from the database of Thomson Financial's Securities Data Company (SDC) Platinum. Transactions include announcement days between 1984 and 2020, in which the status of the transactions is complete. A total of 749 samples meet the above criteria. Big Tech companies like Google and Amazon that generate the majority of their revenues from providing online service (e.g., online advertising) is excluded from the scope in this study because they can neither be categorized into software or hardware sectors.

For the hypotheses testing, I apply the event study methodology from MacKinlay (1997) to calculate the abnormal returns for acquirers around the announcement day. The fundamental premise underlying the application of this methodology is that capital markets are efficient with regard to information that is made publicly available, such as a merger or tender offer announcement (Halpern 1983). This methodology uses stock market data to calculate the performance of M&A participants over the acquisition period as the difference between the shareholders' actual rate of return and their value when that return is conditioned on a specific process that produces expected returns (Halpern 1983). The event time period is set as a three-day event window following the analyses of serial acquirers by Hossain, Pham, and Islam (2021) since the M&As of Big Tech fit the definition of serial acquisitions. The event day is defined as the first official public announcement day of the transaction. To estimate the normal returns of the acquiring firm, I use the market model, a statistical model which relates the return of any given security to the return of the market index. Under assumptions of efficient markets and rational expectations, the market model predicts that firm $i$'s stock return at time $t$ ($R_{it}$) is proportional to a market return.

The announcement day is the event day and written as $t = 0$. To calculate the abnormal return for the acquirer's securities, the event window and estimate window is set.

For the estimate window, I utilize the [-250, -50] interval, which spans 250 trading days before and 50 trading days following the event. For the event window, I use the three-day window of the [-1, 1] interval, which runs from one trading day before the event to one trading day following the event. The [-5, 5] and [-10, 10] event windows are also used to detect early stock price reaction and post-merger stock price reaction, as well as to verify the research model's resilience. On the estimation window [-250, -50], the return of respective acquirer stock is calculated as follows:

$$R_{it} = \frac{P_{it} - P_{it-1}}{P_{it-1}}$$

$R_{it}$ is the return of firm $i$'s stock, $P_{it}$ is the stock price of firm $i$ at time $t$, and $P_{it}$ is the stock price of firm $i$ at time $t-1$. The return of market index in the estimation window [-250, -50] is calculated:

$$R_m = \frac{I_{mt} - I_{mt-1}}{I_{mt-1}}$$

$R_m$ is the market return of each firm at time $t$, $I_{mt}$ is the market index of time $t$, and $I_{mt-1}$ is the market index of time $t-1$. The $\alpha$ and $\beta$ of each firm in the estimation window are estimated using an Ordinary Least Squares regression model. The expected return of the respective acquirer in the event window is determined using the market model:

$$E(R_{it}) = \alpha_i - \beta_i R_m$$

$E(R_{it})$ is expected return of acquiring firm stock $i$ for event day $t$, $\alpha_i$ is the intercept of $R_i$ and $R_m$, and $\beta_i$ is the slope of $R_i$ and $R_m$. The abnormal return is calculated as the difference between observed return and expected return:

$$AR_{it} = R_{it} - E(R_{it})$$

$AR_{it}$ is the daily abnormal return of acquiring firm stock $i$ for event day $t$, $R_{it}$ is observed return of the acquiring firm stock $i$ for event day $t$, and $E(R_{it})$ is expected (normal) return of the acquiring firm stock $i$ for event day $t$. The cumulated abnormal returns (CARs) for the different event windows $[t_1, t_2]$ are calculated:

$$CARs_{[t_1,t_2]} = \sum_{t=t_1}^{t_2} AR_t$$

In the next section, the null hypotheses are tested to see whether the cumulative abnormal returns equal zero or not. If the outcome is not zero and statistically significant, the cumulative abnormal returns are not generated by chance, but rather by the transaction's announcement. The null hypothesis of this study is that if the disclosure of transactions has no effect on the stock price, the mean of cumulative abnormal returns is equal to zero. I use a one-sample t-test to see if the CARs are statistically different from zero.

# Chapter 4. Results

I employ the one sample t-test based on a two-tailed test for the difference in means against zero. Hypothesis 1 and hypothesis 2 posit that that tech giants' acquisition of software targets results in positive abnormal returns for the acquirer. I divide the samples into two groups, tech giants' software acquisition and hardware tech giants' software acquisition to test for synergy realization.

**Table 3. Event study results**

| **Type of acquisition** | **Event window** | **CARs** | $\boldsymbol{t\text{-}statistic}$ | $\boldsymbol{N}$ |
|---|---|---|---|---|
| Software-software | [-1, 1] | 0.00428 | 2.4658** | 363 |
| Hardware-software | [-1, 1] | -2.62e-4 | -0.2022 | 386 |
| Software-software | [-5, 5] | 0.00735 | 2.5456** | 363 |
| Hardware-software | [-5, 5] | -6.67e-4 | -0.2818 | 386 |
| Software-software | [-10, 10] | 0.01405 | 3.3652*** | 363 |
| Hardware-software | [-10, 10] | -4.61e-5 | -0.0135 | 386 |

Note. *p < .05, **p < .01, ***p < .001

Table 3 presents the abnormal announcement period returns for the two groups. The [-1, 1] event window CARs for the software tech giant transactions is 0.00428 for the acquirer and statistically significant. The CARs for hardware tech giant transactions is -2.62e-4, yet statistically not significant. To test whether the synergy realization continues to hold for different event windows, I run additional t-tests for windows [-5, 5] and [-10, 10]. For the [-5, 5] and [-10, 10] windows, the CARs for software tech giant transactions are 0.00735 and 0.01405 respectively, and statistically significant. However, the CARs for hardware tech giant transactions are -6.67e-4 and -4.61e-5, yet not statistically significant. In conclusion,

the first hypothesis that the abnormal returns for software tech giants' horizontal acquisition of software firms will be positive is supported. However, the second hypothesis that the abnormal returns for hardware tech giants' vertical acquisition of software firms will be positive is not supported. These results hold over [-1, 1], [-5, 5], and [-10, 10] windows in the univariate analysis.

H3 posits that hardware tech giants' acquisition of software firms (vertical acquisition) may bring lower abnormal returns than software tech giant acquisition of software firms (horizontal acquisition). With other deal-specific features controlled, moderated multiple regression is utilized to test for the continuity of the synergy. Further, the incremental contributions of the explanatory variable effects are analyzed in a stepwise fashion. In each regression model, the CARs of the [-1, 1] event window are the dependent variables. The independent variables are utilized to account for other key factors that may have a notable impact on the results. The following is the formula:

$$\begin{aligned} CARs = \beta_0 + \beta_1 Software\ Giant + \beta_2 Cash\ Payment + \beta_3 Stock\ Payment \\ + \beta_2 Mixed\ Payment + \beta_3 Public\ Target + \beta_3 Private\ Target \\ + \beta_3 Subsidiary\ Target + \beta_4 Acquirer\ Experience \end{aligned}$$

CARs, the cumulative abnormal returns based on the market model in the [-1, 1] event window, is the independent variable. Software tech giants' acquisition of software firms is classified as the software tech giant dummy variable. Transactions with cash consideration offers are categorized as the cash payment dummy variable. The stock payment variable is an indicator variable that equals one, if the method of payment is through shares, and zero otherwise. The mixed payment variable is an indicator variable that equals one, if the method of payment is through cash as well as shares, and zero otherwise. Targets that are listed on the stock exchange are classified as the public target dummy variable. The private target

variable is a binary indicator that equals one if the target is a private company. The subsidiary target variable is a binary indicator that equals one if the target is a subsidiary company that is not publicly traded on a stock exchange, with a parent company owning more than 50% of the company's share. The acquirers' experience variable is defined as the number of M&A transactions from the same industry at the four-digit SIC level within five years before the specific deal.

The means and standard deviations for the research variables are shown in Table 4. The correlations are shown in Table 5. All correlations are well under the recommended 0.8 threshold that would indicate problems with multicollinearity (Gujarati 1995).

**Table 4. Variable means and standard deviations**

| **Variable** | **Mean** | **S.D.** |
|---|---|---|
| CARs [-1, 1] | 0.00194 | 0.0295 |
| Software giant | 0.486 | 0.500 |
| Payment cash | 0.181 | 0.386 |
| Payment stock | 0.0614 | 0.240 |
| Payment mixed | 0.00392 | 0.0625 |
| Target public | 0.144 | 0.351 |
| Target private | 0.709 | 0.455 |
| Target subsidiary | 0.145 | 0.352 |
| Acquirer experience | 28.8 | 12.8 |

**Table 5. Correlations**

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 1. CARs [-1, 1] | | | | | | | | | |
| 2. Software tech giant | 0.077* | | | | | | | | |
| 3. Payment cash | 0.033 | -0.064 | | | | | | | |
| 4. Payment stock | -0.069 | -0.107** | -0.120*** | | | | | | |
| 5. Payment mixed | 0.053 | -0.019 | 0.030 | -0.016 | | | | | |
| 6. Target public | -0.018 | 0.056 | 0.483*** | 0.050 | 0.094** | | | | |
| 7. Target private | -0.009 | -0.010 | -0.362*** | 0.020 | -0.052 | -0.639*** | | | |
| 8. Target subsidiary | 0.025 | -0.036 | -0.011 | -0.074* | -0.026 | -0.169*** | -0.642*** | | |
| 9. Acquirer experience | 0.025 | 0.026 | -0.035 | -0.017 | -0.020 | -0.005 | 0.063 | -0.067 | |

Note. *p < .05, **p < .01, ***p < .001

Table 6 shows results from the multiple regression analysis. None of the control variables exhibited statistically significant effects on the standardized abnormal returns except for stock payment. The independent effect for stock payment is negative and significant ($p < 0.05$), which supports previous findings that stock considerations lead to negative abnormal returns for the acquirer (Datta, Pinches, and Narayanan 1992, Bruner 2004). The control variables' findings support the meta-analyses by King et al. (2004) that few variables consistently affect merger performance. Model 2 has a substantial F-statistic ($p < 0.01$), showing that the addition of the software tech giant variable coefficient improves the model. Specifically, software tech giant acquisition is significant and has a positive impact on abnormal stock returns ($p < 0.01$). When other independent variables are controlled, the synergy effects of software target acquisition for the acquiring software tech giant continue to hold. This suggests the notion that software tech giants experience abnormal returns higher than hardware tech giants, providing support for hypothesis 3.

**Table 6. Regression model results**

| **Variable** | **Model 1** | **Model 2** |
|---|---|---|
| Constant | 0.01821 | 0.01822 |
| Software giant | | 0.00572** |
| Payment cash | -3.158e-5 | 0.00158 |
| Payment stock | -0.01185* | -0.01057* |
| Payment mixed | 0.03331 | 0.03426 |
| Target public | -0.02051 | -0.02510 |
| Target private | -0.01872 | -0.02173 |
| Target subsidiary | -0.01479 | -0.01748 |
| Acquirer experience | 6.270e-5 | 6.20e-5 |

| | | |
|---|---|---|
| $F\text{-}statistic$ | 1.84 | 2.56** |
| $R$ | 0.138 | 0.173 |
| $R^2$ | 0.0190 | 0.0298 |
| $Adjusted\ R^2$ | 0.0086 | 0.0181 |

Note. *p < .05, **p < .01, ***p < .001

Table 7 shows the means of CARs [-1, 1] and the t-statistics of one-sample t-tests of the six tech firms included in the analyses. In general, software acquirers (Adobe Systems, Microsoft, Oracle) yield positive abnormal returns which is consistent with the results of Table 6. Hardware acquirers (Hewlett Packard, IBM) yield zero or negative abnormal returns, with the exception of Cisco Systems. The CARs of IBM in a three-day event window is -0.00266 and statistically significant (p < .05) and the CARs of Microsoft in a three-day event window is 0.00645 and statistically significant (p < .001), which signify that these test values are significantly different from zero.

**Table 7. Announcement day CARs for six tech giants**

| **Group** | **Acquirer** | **CARs [-1, 1]** | $\boldsymbol{t\text{-}statistic}$ | $\boldsymbol{N}$ |
|---|---|---|---|---|
| Software | Adobe Systems | 0.00267 | 0.3319 | 50 |
| Software | Microsoft | 0.00645 | 3.3804*** | 190 |
| Software | Oracle | 0.00157 | 0.5961 | 123 |
| Hardware | Cisco Systems | 0.00327 | 1.3359 | 149 |
| Hardware | Hewlett Packard | -0.00154 | -0.3855 | 59 |
| Hardware | IBM | -0.00279 | -2.0139* | 178 |

Note. *p < .05, **p < .01, ***p < .001

# Chapter 5. Discussion and Conclusion

How acquiring firms create value in M&A is an enduring research qsuestion in M&A studies of the IS (e.g., Léger and Quach 2009, Gao and Iyer 2006, Chang and Cho 2017, Bruyaka et al. 2015, Rheaume and Bhabra 2008), finance (e.g., Hossain, Pham, and Islam 2021, Bruner 2004), and strategic management (e.g., Zollo and Meier 2008, Seth, Song, and Pettit 2002) disciplines. This study contributes to the M&A literature in IS by narrowing the acquiring firm to tech giants in the software sector and hardware sector. The operationalization of the target, the software business, is used to explicitly compare the different yields of the two types of acquirers. The theoretical explanation for the varying stock market reactions is given as well as the empirical evidence to support the hypotheses.

In examining short-run abnormal stock returns (CARs), software tech giants' returns from software target acquisitions create potential synergies from network effects and mutually compatible operational culture. Hardware tech giants' returns of software firm acquisition are expected to create potential synergies from the complementarities of software and hardware product diversification. Instead, the empirical context show that short-run abnormal stock returns failed to create synergistic effects for the acquirer. These findings indicate that the value-creation effects of software target acquisition may be reinforced by the compatibility of operational culture between the merging companies.

The IS discipline recognizes software-led expansion as an important source of growth and focuses on antecedent mechanisms of successful software strategies (Gallaugher and Wang 2002). The M&A literature in IS recognizes that online firms as M&A targets are able to yield positive returns to the acquirer (Uhlenbruck, Hitt, and Semadeni 2006). However, well-established tech giants' distinct diversification strategies have not sufficiently been

visited. That is, insufficient research in IS literature has been done to link different types of tech giants' expansion of software through M&A transactions, nor has the theoretical grounds been developed to explain whether, how, and why software target acquisitions affect acquirer performance. This study contributes by theoretically explaining and empirically validating the link between tech giant's foundational product sector and the performance of software-led M&As. In examining short-run abnormal returns, due to the organizational dissimilarities among hardware tech giants and software targets, the potential of synergy creation may be thwarted.

The results serve as a cautionary tale to hardware-based tech companies. While it may be tempting to veer into either IT convergence, subscription business, or digital transformation, which are the trajectories set by tech giants, there exists a steep learning curve to master a viable software-centric business model. The mastery required in manufacturing, supply chain, logistics, marketing, and distribution may already be a handful for some hardware companies. Even with their top-notch financial, experiential, and human resources, hardware tech giants included in the analyses could not reach the full potential of the software-led expansion approach. The detrimental stock returns experienced by some of hardware tech giants' acquisitions in the analyses could prove to be fatal to less established tech companies.

Moreover, CEOs can use these findings to raise awareness of the importance of post-merger integration, especially when the operational culture of the acquirer and target are not analogous. Computer hardware manufacturers are increasingly making a pivot from hardware to software, security, and services, seeking to expand their technology stacks. The premerger assessment and post-merger integration should not neglect the operational and cultural fit of the merging firms. To reduce the risk of M&A failure, top management must

assist employees in coping with the changes they are experiencing in the post-merger stage (Appelbaum and Gandell 2003). M&A integration initiatives should, therefore, make sure that the positive values of the merging companies meet the least resistance in the process. In fact, a case study conducted in 2013 points to Cisco's prioritization of cultural assessment as a success factor of acquisitions, which reflects the results of Table 7, in which Cisco is the only hardware acquirer to gain positive abnormal returns. Cisco forms integration teams early in the post-merger process and the top management is approachable to new employees, actively participating in the entire process (Appelbaum, Roberts, and Shapiro 2013). Cisco also uses a mentoring system where Cisco veterans support an acquired manager in order to effectively transfer Cisco's values to the acquired firm, increasing mutual dependence of the merging firms (Appelbaum, Roberts, and Shapiro 2013). Contrastingly, the results of the one-sample t-test reveal Hewlett Packard's track record of historical mergers and acquisitions to bring largely negative returns. In fact, according to an article published in Stanford Business, one of the most controversial mergers of HP, the merger of Compaq Computer Corp., was executed poorly in the post-merger stage. Unlike Cisco's strategy for M&A integration, the integration team that was formed for pre-approval activities was immediately dissolved in the post-merger execution.[16] More critically, the top management failed to communicate the new corporate strategy with key customers about the identity of HP as a company with a legacy of breakthrough innovation.[17] Instead, the operational efficiency was emphasized with the addition of Compaq Computer.[18] Thus, the failure can be attributed to the neglection of the management to understand the level of compatibility of operational culture.

[16] https://www.gsb.stanford.edu/insights/compaq-hp-ultimately-urge-merge-was-right
[17] https://www.gsb.stanford.edu/insights/compaq-hp-ultimately-urge-merge-was-right
[18] https://www.gsb.stanford.edu/insights/compaq-hp-ultimately-urge-merge-was-right

Several limitations of our study offer opportunities for future research. These results are limited to the selected six tech giants representing software tech giants and hardware tech giants, and thus there is the potential issue of generalizability. This presents the opportunity for a wider scope of analyses to include more tech giants that include service-centered Big Tech such as Google and Amazon. Further, the target is grouped into one variable, the software business. The acquired company can be categorized as unicorn firms, start-ups, or SMEs (Small and Medium Enterprise), from which the analyses can have implications on the types of acquirers in the IT industry and the synergies created from the classification. Finally, the measure of performance in this paper is based on CARs which captures short-run returns. Long-run returns or accounting measures to assess merger performance can help to paint a broader picture of Big Tech companies' M&A trajectories.

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# 국문 초록

빅테크 기업은 정보기술 산업의 경쟁을 촉진하고 진화시키는 데 중요한 역할을 해왔다. 컴퓨터 하드웨어, 소프트웨어 및 관련 서비스 기업은 혁신적인 소프트웨어가 주도하는 생태계를 구현하기 위해 여러 다각화 전략 및 비즈니스 모델의 변혁을 시도하고 있다. 본 연구에서는 소프트웨어 시장에 내재하여 있는 특성에 대한 이해를 바탕으로 빅테크 기업 인수 시 동반되는 인수합병 이후 기업의 수익률을 정량적으로 측정하고, 인수 기업의 사후적 기업 성과의 변동성에 대한 요인들을 도출하고자 하였다. 1984 년과 2020 년까지 이루어진 749 건의 빅테크 기업 인수합병 데이터를 수평 확장과 수직 확장으로 분류하여 분석한 결과, 소프트웨어 기반의 빅테크 기업의 소프트웨어 인수합병 공시는 인수자 주주들에게 유의한 정의 비정상 수익률을 가져왔다. 반면 하드웨어 기반의 빅테크 기업의 소프트웨어 인수합병 공시는 주주들에게 유의한 수익률을 가져오지 않았다.

**주제어:** 빅테크 기업, 인수합병, 시너지 효과, 사건 연구, 비정상 수익률