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Short-term Wealth Effects for the Acquirer: Does Absorptive Capacity and Industry Relatedness Promote Valuable M&As?

Evidence from EU's Medical Technology Industry

Lyhyen aikavälin tuotot ostajayritykselle: johtavatko absorptiivinen kapasiteetti ja toimialojen samankaltaisuus arvoa luoviin yrityskauppoihin?

Evidenssinä EU:n lääketeknologia-toimiala

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ABSTRACT

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The purpose of this thesis is to examine the acquisition's short-term returns for the acquirer. This thesis includes an event study examining post-acquisition performance measured by cumulative average abnormal returns (CAARs) in the event window of an acquisition announcement. The short-term returns are used as a dependent variable in a multivariable regression model. The regression model examines the impact of acquirer's absorptive capacity and industry relatedness vis-à-vis target on the short-term wealth effect. Absorptive capacity is measured by R&D intensity and industry relatedness by the settlement of acquirer's and target's SIC-codes. The evidence for this thesis is from the EU's medical technology industry in the years 1990–2018. This thesis' results demonstrate that the acquirer has significant positive abnormal returns during an acquisition announcement. This thesis' did not find evidence to support the absorptive capacity and industry relatedness theories as the multivariable regression results were nonsignificant.

TIIVISTELMÄ

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Tämän kandidaatintutkielman tavoitteena on tutkia ostajayrityksen lyhyen aikavälin osaketuottoja yrityskaupan julkaisupäivän ympärillä. Lyhyen aikavälin tuottoja tarkastellaan tapahtumatutkimuksen avulla ja niiden mittarina on kumulatiivisten epänormaalien tuottojen keskiarvo (CAAR). Lyhyen aikavälin tuottoja käytetään usean muuttujan regressiomallissa riippuvana muuttujana. Regressiomallin avulla tutkitaan vaikutuksia, joita ostajayrityksen absorptiivisella kapasiteetilla ja toimialojen samankaltaisuudella on lyhyen aikavälin tuottoihin. Absorptiivista kapasiteettia mitataan R&D intensiteetillä ja toimialojen samankaltaisuutta mitataan vertaamalla ostajayrityksen ja kohdeyrityksen SIC-koodeja. Tutkielman evidenssi on EU:n lääketeknologia-toimialalta vuosilta 1990–2018. Saatujen tulosten perusteella voidaan havaita, että ostajayritys saa tilastollisesti merkitseviä positiivisia epänormaaleja tuottoja yrityskaupan julkaisupäivän ympärillä. Tutkielma ei löytänyt tukea absorptiivisen kapasiteetin ja toimialojen samankaltaisuuden teorioille, sillä usean muuttujan regressiomalli ei osoittanut tilastollisesti merkitseviä suhteita.

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1. INTRODUCTION

This bachelor's thesis examines the acquirer's abnormal returns around the day of an acquisition announcement—furthermore, the acquiring firm's research and development (R&D) intensity and industry relatedness to the target firm are examined to explain these abnormal returns. Mergers and acquisitions (M&As) are corporate transactions in which the acquirer possesses parts or the entire target firm to have wealth through synergistic gains (Lee & Lee, 8; Kallunki, Pyykkö & Laamanen 2009, 840). Worldwide M&A values exceeded 4.5 trillion US dollars in 2015; the M&As have a distinct impact on the whole economy (IMAA 2020). The main question of the current academia has been whether acquisitions are profitable for the acquirer. In the present state, the overall answer has been ''no''. (King, Dalton, Daily & Covin 2004, 192) Several theories have been trying to explain why most acquisitions fail, including managerial hubris and agency theories (Sorescu, Chandy & Prabhu 2007, 57-58).

Short-term abnormal returns around the announcement day are essential to study because of their implications on the acquirer's investors' expectations of the acquisition success (Rani, Surendra & Jain 2015, 294). For example, arbitrage investors exploit these abnormal returns (Officer 2007, 794). There is no consensus amongst researchers whether the acquirer has positive or negative abnormal short-term returns during the event window of an M&A announcement (Martynova & Renneboog 2008, 2153; Neelam, Singh & Kumar 2016, 5). Campa and Hernando (2004, 64) studied domestic deals inside the EU and found that acquirer's short-term abnormal returns measured in cumulative average abnormal returns (CAARs) were +0.61 percent. Byrd and Hickman (1992) and Graham, Lemmon, and Wolf (2002) found negative CAARs of -1.23 percent and -0.78 percent, respectively.

Moreover, current M&A research has examined the deal participants' specific characteristics, which may have a value-creating or value-eroding effect on the transaction outcome. King, Wang, Samimi, and Cortes (2020) proposed in a recent meta-analytic integration that more evidence from particular firm-specific characteristics is needed to understand M&As wealth creation better. As proposed, this thesis focuses on the acquirer's industry relatedness to the target firm and R&D intensity as predictors of short-term post-acquisition performance in a multivariable regression model. According to Hitt, Hoskisson, Ireland, and Harrison (1991, 694), R&D investments positively correlate with the firm's long-term performance. Via an acquisition, the acquirer can absorb the target's knowledge base for innovation benefits. The absorptive capacity theory explains the absorption capabilities of the acquirer. Absorptive capacity is the firm's capability to absorb new knowledge from outside sources, and it is vital in the success of an M&A transaction (Cohen and Levinthal 1990, 128; Minbaeva, Pedersen, Bjorkman, Fey & Park 2003; Van Wijk, Jansen & Lyles 2008). The strategic fit theory explains the effects of deal participants' industry relatedness on the short-term returns. Strategic fit is the firm's resources' alignment with its strategy and the environment (Channon & McGee 2015, 1). According to Gleich (2010, 5-6), the greater the deal participants' strategic fit, the greater the post-M&A performance; synergistic gains from economies of scope and scale are achievable. Evidence demonstrates that high-technology M&As succeed when the acquirer is also in the high-technology industry (Alhenawi & Stilwell 2019, 352-353). High-technology acquisitions have overall raised the interest of academics in recent years, for example, in *Ahuja and Katila (2001), Benson and Ziedonis (2009),* and *Capron and Mitchell (2009).* In these studies, high-technology industries have been used to evaluate innovation's effect on the acquisition outcome. (Ahuja & Katila 2001, 199; Boni 2018, 42-43)

1.1 Research objectives and structure of the thesis

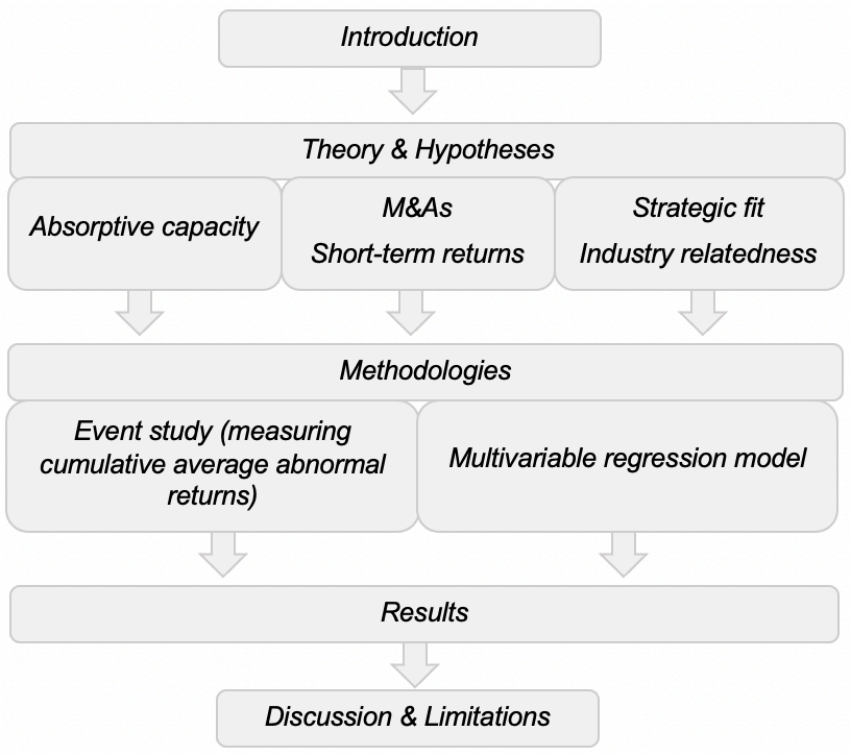
Most of the previous M&A studies have controlled the effects of the industry by conducting mixed-industry studies. Moreover, the single-industry studies conducted have focused on related markets, biotechnology, and pharmaceuticals, for example, in *Danzon, Epstein,*

and Nicholson (2007), Kirchhoff and Schiereck (2011), and *Hassan, Patro, Tuckman, and Wang (2007)*. Academia has not researched the medical technologies in terms of M&As, and thus this thesis will give more insights from a different high-technology industry. The medical technology market's future profits and the degree of R&D invested are dubious due to the EU's new regulation. Regulations 2017/745 and 2017/746 will be effective from May 2021. It will affect a medical device's patent process by stricter ex-ante quality controls and the devices' risk classification. As the market is consisting 95 percent of small-to-medium size firms, the new regulation may hinder the R&D activity and therefore M&As. (Maresova, Hajek, Kerjcar, Storek & Kuca 2020, 1-6; EU 2017/745; EU 2017/746; MedTech Europe 2019, 20) This thesis serves a preliminary purpose, thus studying the acquisition performance before the regulation is in practice.

The thesis aims to study whether an acquirer of a medical technology target has significant positive short-term cumulative average abnormal returns after completing an acquisition inside the EU. Acquirer's R&D intensity and industry relatedness to the target are studied as explanatory variables for the returns. It can be presumed that only does not the level of the target's R&D intensity enhances the acquirer's innovative process, and as a result, the success of the M&A. Acquirer's R&D intensity may have an interaction effect on the transaction outcome as it may lead to better absorptive capacity. The acquirer may be able to use the acquired knowledge more effectively when its R&D intensity is higher. The industry relatedness of the participants may have similar effects. It is presumed that innovation benefits may be better absorbed in firms in the same industry, as they have similar knowledge structures. From these objectives derive the following main research question.

Main research question: When do high-technology acquisitions lead to positive abnormal returns?

In the pursuance of answering the main research question, hypotheses are presented in the second chapter. The rest of the thesis will continue as follows. First, an overview of theories regarding M&As and short-term wealth effects is presented. The absorptive capacity theory is presented, explaining the impact of acquirer's R&D intensity on the short-term wealth effects. Theories of strategic fit and an overview of industry relatedness studies are presented. From the theoretical perspective, the methodologies used in this thesis are presented. An event study is conducted to measure the cumulative average abnormal returns inside the event window. The event study results are further used as a dependent variable in the multivariable regression model, which will explain the effects of R&D intensity and industry relatedness on the short-term wealth effect. Results are presented and hypotheses are answered at the end of this thesis, in Chapter 4. Discussion and limitations will follow the results to conclude the thesis. Graph 1 below presents the structure of the thesis.



Graph 1 Structure of the thesis

2. THEORY AND HYPOTHESES

Relevant theories regarding the topic of this thesis are presented in this chapter. An overview of M&A theories and short-term return studies are presented. Moreover, the absorptive capacity, strategic fit, and industry relatedness theories are presented.

2.1 Mergers and acquisitions

In mergers and acquisitions (often abbreviated as M&A), a company or the ''acquirer'' (in some literature referred to as bidder) obtains parts of another company or the ''acquiree'' (in some literature referred to as the target). The terms ''merger'' and acquisition'' do not imply the same transaction type. In mergers, two companies form one legal entity. In an acquisition, the two firms stay separate in legal terms, but the acquirer possesses the target's rights partially or completely, usually in terms of common stock. (Moeller 2009, 227, 232) The acquirer firm generally pays a premium for the target shareholders, most often in cash, stock, or combination (Officer 2004, 2719). M&A types divide into horizontal and vertical transactions. In a horizontal transaction, deal participants are in the same industry and share similar customers with different production pipelines. In a vertical transaction, deal participants are in different positions in the same production pipeline, thus creating a supply-chain advantage for the acquirer. Specifications of the deal participants may also divide the deals into a conglomerate or a concentric transaction; the further meaning transaction between participants in different business domains entirely. The latter are transactions between participants that share similar customers and production. (Katramo, Lauriala, Matinlauri, Niemelä, Svennas & Wilkman 2013, 26-28) Merger and acquisition volume has also been proven to change cyclically over time, following the general macroeconomic trend. The first M&A wave started in the 1890s, and the modern sixth wave may have begun in 2003. (Gregoriou & Renneboog 2007, 1-2, 5; Martynova & Renneboog 2008, 2)

Several theories explain M&A motives. The most general theories are neoclassical theories, agency theories, and behavioral theories. (Alhenawi & Stilwell 2019, 3; Anderson, Medla, Rottke & Schiereck 2012, 39) Neoclassical theories explain the motives behind M&A as an ex-post event after an exogenous economic, technological, financial, or regulatory shock. These theories expect that management choices are concordant with investors' motives; M&As ex-post shocks lead to profit optimization. (Martynova & Renneboog 2008, 2169) Conversely, agency and behavioral theories demonstrate that expectations of management's commitment to fiduciary duties proposed in the neoclassical theories are biased, leading to value-eroding M&As. Some of the M&As may be motivated by ''emporium'' building by the acquirer's current management. Emporium building means that the management executes M&As, which may not create value for the shareholder. Biased management action creates a conflict of interest between the firm's insiders and investors. (Jensen 1986, 323, 327) Management of the acquirer may aim for the firm's relatively fast growth as the growth leads to higher bonuses and other benefits for the management (Anderson et al. 2012, 39). As Mueller (1969, 643-645) stated, a firm's size is associated with compensation rather than profitability. The investors may not benefit from the acquisitions as they are mostly motivated by the growth in size and not by profitability (Jensen 1986, 323, 327).

Managerial hubris is another phenomenon affecting M&A motives. In managerial hubris, overconfident managers participate in M&As in which they overestimate their capability to conclude the transaction leading to less profitability. (Roll 1986; Rau & Vermaelen 1998) More recent theories explaining the M&A motives include market timing, which demonstrates that M&A may be motivated by exploiting short-term market ''misvaluation'' (Dong, Hirshleifer, Richardson & Teoh 2006, 725-726). Myers and Majluf (1984, 3-6) state that management might use cheap equity to acquire real assets. The use of cheap equity in acquisitions may lead to value-eroding transactions since the management may be prone to execute acquisitions with a lower net present value.

2.2.1 Short-term wealth effects

The previous results of the acquisition's short-term wealth effects around the announcement day of acquisition are rather inconclusive, especially for the acquirer. Overall, acquirers seem to experience insignificant short-term returns before and after the announcement. For the target firm, positive short-term returns seem to be rather constant regardless of the M&A wave in which the studied M&As occurred. (Martynova & Renneboog 2008, 2153, 2159) The short-term wealth effects reflect investor's expectations on the success of the M&A. The common methodology for analyzing short-term wealth effects before and after acquisition since the 1970s is the event study. Event study holds the premise that M&A's present the ''discounted value of the firm's future stream of profits.'' The change in firm value during the announcement of the M&A is a shift in investor's valuation of the future revenue. (Rani et al. 2015, 294) The announcement of an acquisition brings new information to the market, and therefore it may affect the stock returns inside the event window of the announcement. Fama, Lawrence, Jense, and Roll (1969) introduced the impact of new information on stock prices, and later Fama (1970) formed the efficient market hypothesis. M&A's effects on the stock price near the announcement date represent the semi-strong form of the hypothesis; the abnormal returns suggest that the market does not absorb the acquisition's new information directly into the acquirer's stock price (Pike & Neale 2003, 48). For example, merger arbitrages exploit the market's inefficiencies during the announcement of an M&A as an investing strategy (Officer 2007, 794). Abnormal returns before the announcement day of the acquisition may signal information leakage, which affects the acquirer's shareholder value (Holmström 2017, 35). The abnormal returns are commonly estimated using the Market model by calculating the difference between realized return and a benchmark return (Gregoriou & Renneboog 2007, 8; Martynova & Renneboog 2008, 8).

Table 1 presents results from previous short-term return studies in different periods and follows a summarization by Martynova and Renneboog (2008, 2154-2158). Types of M&A's are notated by "*M"* referring to a merger; *"Mix"* referring to a combination of cash

and stock offer; *"TO"* referring to tender offer; *"RMA"* referring to related M&A, "*Hubris"* relating to managerial hubris, *"UMA"* referring to unrelated M&A. Table 1 shows that acquirer's cumulative average abnormal returns (CAARs) vary between [-4.13, +4.60] percent. There is no distinct difference between periods. In Campa and Hernando (2004), domestic deals inside the EU resulted in +0.61 percent CAARs. Both studies conducted in Sweden by Doukas et al. (2001) and Holmen and Knopf (2004, 167) resulted in positive CAARs, +2.74 percent and +0.32 percent, respectively. The studies mentioned above represent both related and unrelated acquisitions.

Table 1 Results from previous short-term return studies, following summarization by Martynova and Renneboog (2008)

Study	*Sample country*	*Sample period*	*Benchmark return model*	*Type of M&A*	*Event window (days)*	*CAARs Acquirer (%)*
Franks et al. (1977)	UK	1955-72	MM, TTA	M	(0, +20)	+ 4.60
Dong et al. (2006)	US	1964-82	MM	Mix	(0, +20)	+ 2.10
Dodd (1980)	US	1970-77	MM	M	(-20, 0)	+ 0.8
Bouwman et al. (2003)	US	1979-98	MAM	M-mixed	(-1, +1)	+ 2.33
Byrd & Hickman (1992)	US	1980-87	MM	TO	(-1, 0)	- 1.23
Graham et al. (2002)	US	1980-95	MM	All MA	(-1, +1)	- 0.78
Doukas et al. (2001)	Sweden	1980-95	MM	RMA	(-5, +5)	+ 2.74
Holmen & Knopf (2004)	Sweden	1985-95	MM	TO	(-5, +5)	+ 0.32
Raj & Forsyth (2003)	UK	1990-98	MAM	Hubris	(-20, +5)	- 4.13
Bhagat et al. (2005)	US	1997-00	MM	TO	(-5, +5)	+ 0.97
Campa & Hernando (2004)	EU	1998-00	CAPM	Domestic deals	(-1, +1)	+ 0.61
Akbulut & Matsusaka (2003)	US	2000-02	MAM	UMA	(-2, +1)	- 0.18

From these selected studies across periods, it can be concluded that the acquirer's CAARs are slightly positive during the event window. From these standpoints derive hypothesis 1.

Hypothesis 1: Acquirer exhibits positive cumulative average abnormal returns around the announcement day of the acquisition

It can be expected that the acquirer has positive CAARs during the event window since similar effects are demonstrated in studies conducted inside the EU in both related and unrelated acquisitions. As the market can be hypothesized to be semi-strong in form, the acquisition's information does not effectively transfer into the acquirer's stock pricing, and therefore the abnormal returns may exhibit during the event window. As the studied targets are in the medical technology market, its profitability and long-term growth prospects can be hypothesized to be overvalued by the market, further explaining the positive wealth effect.

2.2 Absorptive capacity

Absorptive capacity is the organization's ability to exploit novel innovations and knowledge from outside sources in both practical and commercial ends (Cohen & Levinthal 1990, 128). Baden-Fuller (1995, 18-21) studied absorptive capacity by how strategic alliances could benefit from shared knowledge. Baden-Fuller (1995, 18) stated five basic assumptions about knowledge; 1) Knowledge is the primary driver for the success of a firm 2) Knowledge is a combination of information, technology, and hands-on skills. In an organization, knowledge is either shared or private within departments or individuals. 3) Knowledge derives from individuals of the organization 4) Because of limitations caused by an individual's time and cognitive capabilities, one should focus on a particular field of knowledge. 5) Production derives from a combination of different knowledges. From the

initial definition of absorptive capacity, Van den Bosch, Wijk, and Volderba (2006, 5) introduced the three capabilities of absorptive capacity: ‘’1. recognizing the value, 2. assimilating and, 3. applying new external knowledge to commercial ends.’’ Lane, Salk, and Lyles (2001, 1140) conducted similar distinctions between the capabilities. Zahra and George (2002) divided the absorptive capacity into potential and realized absorptive capacity. The former describes a firm’s capability to acquire new knowledge and later to exploit the acquired knowledge. Common studies focus on R&D invested and scanning of outer possibilities. There is little evidence on the effects of internal organization on the absorptive capacity. For example, managerial practices may ‘’have a distinct impact’’ on the firm’s knowledge structure and absorptive capacity. (Minbaeva et al. 2003) This thesis considers absorptive capacity as the acquirer’s capability to absorb knowledge from the target firm.

Cohen and Levinthal (1990, 136) recognized that absorptive capacity is path-dependent. R&D is closely related to absorptive capacity since it contributes to further advances in it. Additional R&D investments make advances in the firm's cumulative learning. This statement is applicable when learning is relatively easy; the firms are experiencing diminishing returns in the learning curve in more demanding learning environments. A standard and a simplified measurement for a firm's absorptive capacity is the level of R&D intensity, which is R&D spending divided by sales. (Cohen & Levinthal 1990, 135-141)

Pennings and Harianto (1992) studied video banking adoption in the US banking sector. The authors found that the prior cumulative knowledge mostly explained the banks' success in adopting the new video technology. The prior cumulative knowledge had a higher impact on the adoption's success rate compared to R&D investments. There is also evidence from pharmaceuticals that demonstrates that R&D intensity does not merely account for the absorptive capacity. Nicholls-Nixon (1993) found that alliance utilization, experience in relevant technologies, and effective communication with partners affected technology absorption.

Furthermore, Lane and Lubatkin (1998) tested the initial measurement of absorptive capacity (R&D investments divided by sales) by conducting three knowledge variables and five ‘’knowledge-processing-similarity’’ variables. The initial R&D to sales variable only accounted for four percent of the model’s variance, and the additional variables total 55 percent. From these results, Minbaeva et al. (2003, 588) proposed that absorptive capacities are a ‘’dyad-level construct rather than a firm-level construct.’’ This means that a one-sided examination of firm-level variables does not give an adequate picture of the absorptive capacity phenomenon; thus, the examination should transfer to both parties included in the process. The benefit of using R&D intensity as the measurement of absorptive capacity is a relatively straightforward operationalization.

The success of the technology industry M&A is partly due to the knowledge overlap of the companies. Knowledge overlap or nonoverlap is binomial. Overlapped knowledge is absorbed more effortlessly and commonly does not cause integration problems, whereas nonoverlapped knowledge may create friction in the integration. Overlapped knowledge does not create novel innovation as it is more common for new knowledge. (Sears & Hoetker 2013) Related markets studied, such as pharmaceuticals, demonstrate that technology acquisitions create positive innovation performance (Jeon, Hong, Ohm & Yang 2015, 9-10). Moreover, Higgins and Rodriguez (2006, 352) found that “deteriorating R&D productivity” makes the firm more prone to acquisition. Miyazaki (2009, 201) found a positive correlation between R&D investment and M&A’s in high-technology industries; acquirers expect synergy effects or higher levels of R&D intensity from the acquisition.

As there are none similarly conducted studies with evidence from the medical technologies industry, this thesis hypothesizes similar causalities concerning the adoption of new technology, as the market fundamentals are similar. Minbaeva et al. (2003) and Van Wijk et al. (2008) demonstrate that knowledge transfer and the deal participants' absorptive capacity are rather vital in the success of an M&A. Duflos and Pfister (2008) demonstrated that acquirer’s R&D intensity is beneficial in the knowledge absorption from the target firm. Björkman, Stahl, and Vaara (2007) found a positive linear relationship between the

target's absorptive capacity and post-acquisition knowledge transfer. From these standpoints derives hypotheses 2a and 2b.

Hypothesis 2a: Acquirer's absorptive capacity increases its short-term post-acquisition performance

Hypothesis 2b: Target's innovativeness increases the acquirer's short-term post-acquisition performance

This thesis hypothesizes that the acquirer's absorptive capabilities create value for the acquirer as the acquirer can effectively exploit the target's technological capabilities. The process of knowledge transfer might be more effective in higher levels of acquirer R&D intensity. The valuation of these capabilities can be seen in the market as the abnormal returns during the event window. Additionally, the target's R&D intensity might have similar positive effects on the transaction outcome, as the level of knowledge absorption is higher when the target firm is more innovative. As the primary motivation for high-technology acquisitions is R&D advancements, the market might react more positively to higher R&D intensity acquisition than vice versa.

2.3 Strategic fit

Strategic fit is the alignment and interaction of a firm's internal resources, with the overall strategy defined by external resources. Strategic fit can be defined slightly differently for different departments of the firm. For example, marketing and operational departments have different kind of fit. (Channon & McGee 2015, 1) The study of strategic fit evolved from contingency theory, and it also has roots in strategy research (Venkatraman & Camillus 1984, 513-514). Contingency theory endeavors to explain how firms organize their

internal resources in different situations and environments (Otley 2016, 2). Contingency theory holds a premise that the context and the structure should fit well for an organization's success. Context is the firm's external environment, and the structure is the complexity of the firm's internal resources. (Drazin & Van de Ven 1985, 514)

Fry and Schellenberg (1984, 117) made a distinction between congruent and contingent propositions, derived from Dubin's (1976) theory-building-model, in the pursuance of creating a more accurate understanding and prediction of the studied organizational phenomena. Fry and Schellenberg (1984, 117) defined that the laws of theory's variables define congruence, and a stable system state defines contingency in a different condition. There are two types of congruences: macro-and micro congruence. The prior refers to how an organization should organize their internal resources according to the environment, the latter to the relationship between organizations' internal structure and individuals. (Mealiea & Lee 1979, 333-335) The organizational contingency is rather multidimensional, as it simultaneously is the congruent relationship of the internal resources and environment, and the interactions between the ''technical core'' and ''other internal interactions.'' The technical core is the firm's main technical component, and other internal interactions come from different departments. (Thompson 1967) Venkatraman and Camillus (1984, 513-514) stated that ''fit'' is central in strategy research, and the conceptualization is rather diverse. Drazin and Van de Ven (1985, 514-515) defined the fit as the "underlying congruence between context and structure."

Van de Ven and Drazin (1985) distinguish between three different approaches to fit, which have evolved in the contingency theory framework: *the selection, interaction, and systems approach*. The initial view for the *selection approach* is that fit is the assumed "premise underlying a congruence between contexts", such as the environment or technology, and the structure, such as the organization's complexity. The *selection approach* also has natural selection, and managerial selection approaches. (Drazin & Van de Ven 1985, 517-519) In the natural selection approach, the organization's success is part of an evolutionary process where only the best-performing firms may survive (McKelvey 1982). The

managerial selection considers the natural selection approach and states that organizational structure reflects the particular environment, and the main driver for micro-structural patterns are macro-level entities. For example, new legislation affects industries as a whole, industry-level conventions affect firms, and the firm adapts its functions according to these conventions. (DiMaggio & Powell 1983, 147)

Moreover, the *interaction approach* focuses on the performance differences between firms, which derive from the interaction between context and structure. The typical interaction hypothesis of a firm's performance is between the organizational structure (from simple to complex) and the organizational environment (from homogenous to heterogeneous). Dependence of the aforementioned is that complex structures and heterogeneous environments correlate with higher performance. The *selection* and *interaction* approaches focus on the effects of single variables in context and structure and how those affect firm performance. The *systems approach* reacted to the reductive *selection* and *interaction* approaches. *Systems approach* studies the organization performance more holistically, considering ''many contingencies, structural alternatives and performance criteria'' simultaneously. (Drazin & Van de Ven 1985, 517-519) Ford and Slocum (1977, 561-562) state that organizations face many contingencies and the debate among researchers is whether an organization's internal recourses should align with the environment, technology, or organization's size.

An acquisition is also a way of strategic fitting; two separate companies with unique resources merge to gain a competitive advantage, which would not have been possible as separate entities. Firms can adopt new markets, products, technology, and customers rather quickly through M&A's strategic fit. The success of an M&A is in part due to the strategic fit of the parties. (Sunday & Charity 2015, 196, 198) According to Gleich (2010, 5-6), the greater the deal participants' strategic fit, the greater the post-M&A performance; synergistic gains from economies of scope and scale are achievable.

In the strategic fit framework, Shelton (1988, 280-281) divided the types of M&A's to related-complementary fit and related-supplementary fit. Related-complementary fit is close to vertical integration of two firms; the target company provides the acquirer with new products, assets, or skills for production in the acquirer's current market. Related-supplementary fit is close to horizontal integration; the target company provides the acquirer with new customers and markets. Medcof (1997, 722-755) introduced the four C's in determining how well alliance partners strategically fit, which is applicable in M&A's. The first C, capability, is to what extent the target firm can execute the function it was motivated to acquire by the acquirer. For example, in R&D driven M&A, the target should deliver the innovation as agreed. Second C is the compatibility of people, organizational culture, and procedures. Compatibility is essential for efficient operations; organizational friction creates costs for both participants. Third C, commitment, refers to the avoidance of opportunistic behavior of both parties. Both transactions parties should commit to cooperation on a psychological and pragmatic level. Last C is the control's effectiveness between the two companies. For example, in an M&A, the control of two entities changes, disrupting the firms' managerial control.

2.3.1 Industry relatedness

As the importance of strategic fit in an M&A is high, it is worth considering the participants' relatedness effects on the M&A performance as the relatedness may link to higher fit. Shelton (1988, 285) and Lubatkin (1987, 50-53) found better M&A performance for the related deal participants. Conversely, Seth (1990, 115) found no distinct difference in performance for related or unrelated deal participants. The relatedness was initially studied by diversification of the firm's portfolio via M&A, such as in *Berger and Ofek (1995)* and *Capron (1999).* These studies suggest that related diversification created more value for the shareholder compared to unrelated diversification. Although studies had different approaches in methods, it is rather distinct that relatedness affects the transaction outcome. Early studies operationalized industry relatedness as the settlement of acquirers' and targets' Standard Industry Classification Code (SIC). The US Government Office of

Management developed SIC to evaluate a firm's primary economic activities. SIC-codes are from two- to four-digit in length. (Alhenawi & Stilwell 2019, 352, 355) Fertuck (1975, 837) studied the explanatory power of SIC-codes in cross-industry returns and found that three-digit SIC-codes explanatory power was higher compared to two-digit SIC-codes. Palepu (1985, 251) stated that using SIC-codes as a proxy for industry relatedness is rather coarse because they do not imply the ''degree of relatedness.'' The relatively straightforward measurement of industry relatedness using SIC has been under critic by many authors (Alhenawi & Stilwell 2019, 352). More robust alternatives for measurement have been presented, for example, by *Fang and Lang (2000)* (level of supply chain integration), *Kang and Kim (2008)* (geographical proximity), and *Hoberg and Phillips (2010)* (operational and marketing similarities). Different measurements may not be substitutional, and the relatedness should be measured multidimensionally as different kinds of relatedness co-occur in a single M&A. There is evidence that high-technology M&As succeed when the acquirer is also in high-technology. (Alhenawi & Stilwell 2019, 352-353) Canace and Mann (2014, 335-336) demonstrate that the market tends to overreact to M&A's in which both deal participants are in high technology, partly due to overvaluation of R&D intensity. From these standpoints derive hypothesis 3.

Hypothesis 3: Industry relatedness between the acquirer and target firms increases the acquirer's short-term post-acquisition performance

Industry relatedness in medical technology acquisitions may create value for the shareholder in higher short-term abnormal returns than in non-industry-related acquisitions. The higher short-term abnormal returns may be due to the better strategic fit of the deal participants. High-technology M&As are mostly motivated by the R&D pipeline enhancements; firms in the same industry might benefit from the knowledge of similar technologies and markets in which the end products of R&D are distributed.

3. METHODOLOGY AND DATA

The methodology chosen for this thesis is quantitative. This thesis will include an event study and measure the wealth effect by cumulative abnormal returns (CARs) and cumulative average abnormal returns (CAARs). CAARs will be further used as a dependent variable in the multivariable regression model. A descriptive data analysis gives details about the characteristics of medical technology M&A's.

3.1 An industry overview: Medical Technologies

Medical technologies are technologies and devices intended to give diagnosis or treatment for humans. This thesis includes in-vitro diagnostic devices in the definition of a medical technology device. In-vitro devices are used to examine specimens derived from the human body. (WHO 2019, 7) The medical technologies market growth rate has been rather vigorous. The market's value has estimated to be 389 billion US dollars in 2017. In the mid-2020s, the market's value has estimated to be 600 billion US dollars (Research and Markets 2019; Mikulic 2020). The market has provided value for the shareholder. For example, iShares U.S. Medical Devices ETF and S&P Health Care Equipment Select Industry Index has provided fiver-year returns of 22.57 percent and 18.53 percent, respectively (iShares 2020; S&P Dow Jones Indices 2020). The market's growth rate is characterized by innovation and partly by the aging population and its pressure on healthcare expenditure. (WHO 2019, 18, 2011; Boni 2018, 42) Another characteristic of the market is the quantity of small-to-medium size firms, representing 95 percent of the market. (Maresova et al. 2020,1-6) According to Boni (2018, 42), there are approximately 20,000 medical technology firms with yearly revenues under 100 million US dollars and 30-50 firms with revenues exceeding one billion US dollars.

Constant merger and acquisition activity characterize the market; worldwide yearly transaction volumes have remained between 10 and 30 billion US dollars during the 2000s. (The Boston Consulting Group 2012, 11) Motivations for acquiring a medical technology target are commonly related to market segmentation consolidation, portfolio extension, strategic entry, and access to R&D or technology. Market segmentation gives the acquirer access to different geographical areas and clients for additional revenue streams and hedges for macroeconomic changes. Portfolio extension gives a hedge for product line volatility and may give advantages of complementary goods. Strategic entry by non-related industry firms is mostly motivated by prospective higher-than-average margins. Acquisition motivated by R&D is commonly conducted by larger firms, which enhance their internal R&D pipeline by acquiring smaller, innovative companies. (The Boston Consulting Group 2012, 8-11; Robins 2007, 34-38) As the small-to-medium size firms dominate the market, R&D-driven M&As may continue in the future.

3.2 Data

The data used in this thesis is secondary and collected from different databases. The acquisitions for this study were collected from Thomson One's Banker database. The following search criteria were applied: *1. Acquisitions must be fully completed between the years 1990-2018.* This criterion excludes all the in-complete transactions and thus gives more adequate data. *2. Both transaction participants are registered in the EU. 3. The acquirer is a publicly listed company.* This criterion allows the collection of time-series data of acquirer's stock and other financial figures. Stock data and financial figures are collected from Thomson One and Amadeus databases. The deal participants' financial statements are searched for data not found in the databases. Some of the financial statements were not Euro-denominated. A spot exchange and euro denomination were applied. *4. The acquirer possesses a minimum of 50.1 percent of target stocks or other securities that issue holding after completion of the deal. 5. The target SIC-code is limited to companies referring to medical devices.* The SIC-codes are presented in Appendix 1.

The initial search for M&A's using the query above resulted in 624 transactions in total. Each transaction was deliberately evaluated, and some of the deals were dropped from the original sample with the principles below. The following reasons were used to evaluate the transactions: *1. The target company was not a medical technology company*. The SIC-codes used generated target firms in the non-medical rubber-industry and the luxury eye-wear industry. 2. *Either of the deal participants was not inside the EU.* The search query only narrowed countries inside Europe, and there were some countries outside the EU. *3. The acquirer's stock data was not adequate for the whole estimation window of the event study.* Missing stock data during the estimation window led to failure in evaluating the short-term abnormal returns. After eliminating the transactions by the remarks mentioned above, the final sample consisted of 309 transactions.

3.3 Event study

An event study is a standard methodology in finance, economics, and related fields used to study abnormal returns, which might occur when new information or an event enters the market. The event study is time-dependent, and the results might be biased because of external factors and events. Aggregation of results from different companies at different times reduces time-specific error. Before the event window, expected returns of a given stock are observed. (Peterson 1989, 36) In this thesis, the estimation window length will be 250 days. The estimation window length is a vital decision, as it might bias the results if there are non-related events included (Aktas, Bodt & Cousin 2006, 130). In this thesis, the event window will be [-10,10] days from the acquisition's announcement date. The event window enables the evaluation of short-term abnormal returns before and after the announcement day. If abnormal returns occur before the announcement, there might be leakage of private information. On the announcement day and the days after, it is expected that the abnormal returns signal the acquirer's investor's expectations of the acquisition success. In this thesis, the event study is conducted using Microsoft Excel and following the example given by Vaihekoski (2002). First, the excess returns were calculated for all the companies in the data by subtracting daily returns with the risk-free interest of the day

before. The risk-free rate chosen for the estimation is an aggregation of 1-month euro-denominated LIBOR from 1990-1999 and 1-month EURIBOR from 1999-2018. LIBOR was applied since there were no earlier data of EURIBOR available. EURIBOR is a widely assessed risk-free base rate in the Euro area, and thus it is used in this thesis (Euribor rates 2020). Formula 1 presents the calculation of the excess return.

$$R_e = R_d - \left(\frac{i_{rf}^{1kk}}{360 + i_{rf}^{1kk} x 29}\right) \tag{1}$$

In which R_e is the excess return; R_d is the daily return of a stock; i_{rf}^{1kk} is the 1-month risk-free rate of return.

3.4 Capital Asset Pricing Model

Sharpe (1964) and Lintner (1965) introduced the Capital Asset Pricing Model (CAPM). It is a commonly accepted model to assess risk and expected returns in finance. Zabarankin, Pavlikov, and Uryasev (2014) viewed the CAPM from two perspectives: 1) The CAPM is a reconceptualization of Markowitz's mean-variance portfolio theory in which the risk of stock was its variance 2) The CAPM is a linear model, in which the beta measures systematic risk. In this thesis, the CAPM is used in the estimation of expected returns in the estimation window. Formula 2 presents the CAPM formula.

$$(E)R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{2}$$

In which $(E)R_{it}$ is the expected return of security *i;* α_i is alpha of security *i*; β_i is beta of security *i;* R_{mt} is market return index; and ε_{it} is the error term. This thesis's market index

is MSCI Europe since it represents 85 percent of the developed European markets and the historical data is available since the 1990s (MSCI 2020). Formulas 3 and 4 are equitation for the calculation of alpha and beta, respectively.

$$a_i = R_e - \beta * R_{mt} \tag{3}$$

$$\beta = \frac{\sum(R_{mt} - \overline{R_{mt}})(R_e - \overline{R_e})}{\sum(R_{mt} - \overline{R_{mt}})^2} \tag{4}$$

3.5 Cumulative abnormal returns

After the estimation using CAPM, actual returns are estimated. The Formula 5 demonstrates the calculation of actual returns, in which R_a is the actual return. The cumulative abnormal returns are further estimated from the actual returns. Formula 6 presents the calculation of CARs.

$$R_a = R_e - (E)R_{it} \tag{5}$$

$$CAR_{R_{a_{[-10,10]}}}^{(k+1)} = \sum_{m=0}^{(R_{a_{[-10,10]}})} S_m^{(k)} \tag{6}$$

In the pursuance of answering whether the MedTech acquirer has significant positive abnormal returns, cumulative average abnormal returns (CAARs) in different periods are calculated.

3.6 Multivariable regression model

Multivariable regression is a statistical method used widely in economics and other sciences. The regression model predicts real-world phenomena and factors behind the phenomena. (Harrell 2015, 3-4) For this thesis, a multivariable regression is conducted using Stata to study the factors behind the CAARs. The multivariable regression model will follow Kallunki et al. (2009) model in part. Formula 7 demonstrates the regression model.

$$\begin{aligned} CAAR_{it} = \beta_0 + \beta_1 \frac{ACQRD_{it}}{ACQS_{it}} + \beta_2 IND_k + \beta_3 \frac{TARGRD_{it}}{TARGS_{it}} \\ +\beta_4 \log\,(ACQS_{it}\,) + \beta_5 \log\,(TARGS_{it}) \\ +\beta_6 \log(ACQASSET_{it}) + \beta_7 \log(TARGASSET_{it}) \\ +\beta_8 ACQROE_{it} + \beta_9 TARGROE_{it} \\ +\beta_{10} \log\,(VALUE_{at}) \;+\; \beta_{10} EXP_k \\ +\sum_{y=1990}^{2018} \lambda_y YEAR_y \;+ \varepsilon_{it} \end{aligned} \tag{7}$$

In which $CAAR_{it}$ is the cumulative average abnormal returns for acquirer *i* in year *t;* $ACQRD_{it}$ is the research and development expenditures for acquirer *i* in year *t;* $TARGRD_{it}$ is the research and development expenditures for target *i* in year *t;* $ACQS_{it}$ is sales for acquirer *i* in year *t;* $TARGS_{it}$ is sales for target *i* in year *t;* IND_k is an indicator variable equal to one if an acquirer *i* is in the same industry *k* as the target, otherwise equal to zero; $ACQASSET_{it}$ is total assets for acquirer *i* in year *t;* $TARGASSET_{it}$ is total assets for target *i* in year *t;* $ACQGROE_{it}$ is the return on equity for acquirer *i* in the year *t;* $TARGROE_{it}$ is the return on equity for target *i* in the year *t;* $VALUE_{at}$ is value of the acquisition *a* in the year *t;* EXP_k is an indicator variable equal to one if the acquirer has participated in an M&A transaction previously during the timeline, otherwise zero; $YEAR_y$ is an indicator variable equal to one year in *y*; ε_{it} is the error term.

3.6.1 Regression variables

The dependent variable $CAAR_{it}$ (CAAR) is the cumulative average abnormal returns for the acquirer in the event window, and it measures the short-term wealth effect. Independent variables $\frac{ACQRD_{it}}{ACQS_{it}}$ (ACQRDINT), and $\frac{TARGRD_{it}}{TARGS_{it}}$ (TARGRDINT) measure acquirer's R&D intensity and target's R&D intensity, respectively. R&D intensity is collected from the latest financial statement before the acquisition and measures transaction participants' absorptive capacity. The third independent variable IND_k (INDUSTRELAT), is an indicator variable that measures the acquisition participants' industry relatedness. Four-digit SIC-code settles the relatedness. For a better explanation of the CAAR's variance, nine control variables were added to the model. $\mathrm{Log}\,(ACQS_{it})$ (log_ACQTURN) and $\log\,(TARGS_{it})$ (log_TARGTURN) are the sales figures for the acquirer and target firm from the latest financial statement before the acquisition, respectively. These sales figures gave an estimation of the transaction participants' relative size. The size of the total assets also measures the relative size of the participants by variables $\log(ACQASSET_{it})$ (log_ACQASSET), and $\log(TARGASSET_{it})$ (log_TARGASSET). Control variables for relative size were logarithmically transformed for better normality. For example, Sorescu et al. (2007, 67) found a relationship between stock market response, sales, and total assets during an acquisition. Thus, those are controlled.

Acquisition participants relative profitability was controlled by variables $ACQROE_{it}$ (ACQROE), and $TARGROE_{it}$ (TARGROE). These variables are the return on equity (ROE) percent for the acquirer and the target from the latest financial statement before the acquisition, respectively. ROE is ''net income after interest and taxes divided by average common stockholders' equity'' (Lee & Lee 2006, 233). ROE also indicates of the synergies which the acquisition could provide (Kirchhoff & Schiereck 2011, 37). The value of the deal may affect the CAARs, and it is controlled by $\log\,(VALUE_{at})$ (log_VALUE), which is the value of the acquisition logarithmically transformed for better normality. Also, the acquirer's previous M&A experience may affect the CAARs, and it is controlled by the

indicator variable EXP_k (MAEXP). M&A experience is advantageous in post-M&A integration and may affect abnormal returns (Kirchhoff & Schiereck 2011, 39). The abnormal returns may also be affected by the year in which the acquisition was announced. The year of the acquisition announcement is controlled by variable $YEAR_y$ (YEAR).

The variables for the regression model contain missing values because of a lack of adequate data. The disparity in accounting standards in different EU countries and over time are the main reasons for the missing variables. One solution to this problem would have been to drop all the observations with missing data. In a single observation, the data has multiple values, and therefore the number of observations would have dropped substantially. Missing values were linearly imputed in the data to keep the observations at an adequate level. The imputation creates a distinct limitation for the model used. As Laaksonen (2018, 159) stated, a quality check of the imputation is vital. An additional regression is conducted with original data values and fewer observations. Table 4 presents the additional regression results. The differences between the original data's and imputation data's summary statistics are presented in Table 3.

3.6.2 An overview of regression model assumptions

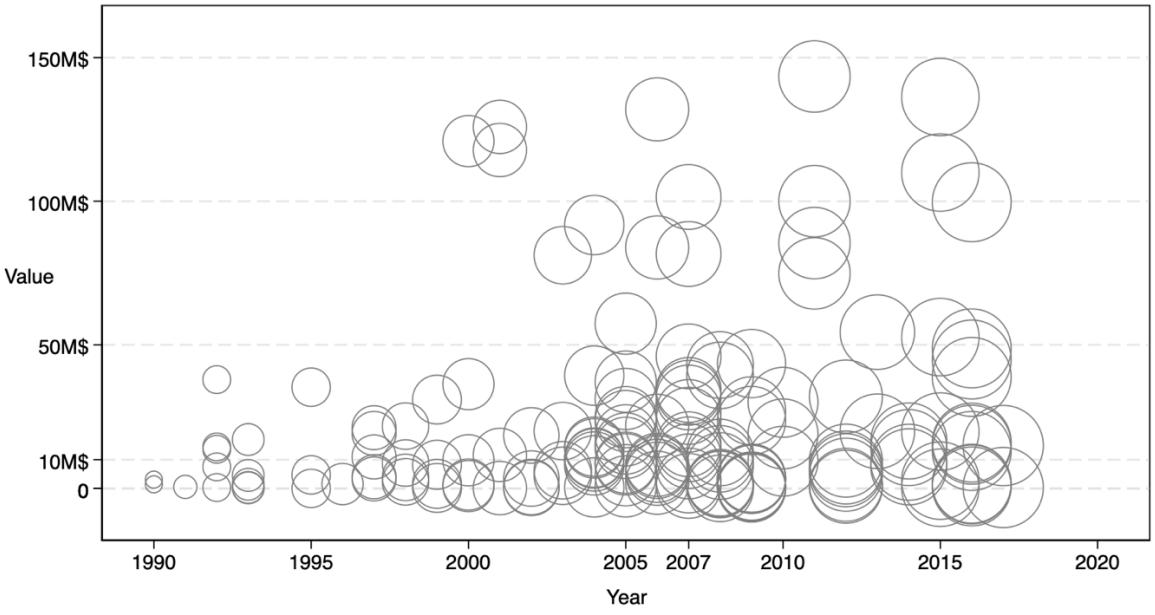
Correlation between variables was first visually examined, and pairwise correlation was conducted. Visual examination demonstrates that there could be some correlation between the variables. CAARs are correlated with almost all of the independent variables. There is a high correlation between most independent variables. For example, the target's and acquirer's R&D insensitiveness correlate by -0.82. The high correlation amongst the variables suggests that there could be multicollinearity in the model. Appendices 2 and 3 present the correlation matrix and results from the pairwise correlation, respectively. The variance inflation factor (VIF) test demonstrated a mean of 3.28. According to Eye and Schuster (1998, 137), if the VIF is higher than 10, the model has severe multicollinearity. Some of the variables showed higher VIF numbers. It is concluded that the model contains

some multicollinearity, but it does not compromise the model. Appendix 4 presents results from the VIF-test. Heteroskedasticity was first visually examined by two-way scatter of predicted y variable and studentized residuals. Visual examination reveals that the model is heteroscedastic, and the variance is not constant. The studentized residuals vertically center around zero. Breusch-Pagan test proves the initial concern and demonstrates that the model is heteroskedastic. Appendices 5 and 6 demonstrate the results from the Breusch-Pagan test and the two-way scatter of predicted y and studentized residuals, respectively.

The normality assumption of the model was evaluated by conducting a skewness and kurtosis test of normality for the residuals. Residual's skewness is 0.60 and kurtosis 3.41. According to Srinivasan and Lohith (2017, 77), the model's skewness is severe if it is over four, and kurtosis is severe if it is over three. The skewness should not compromise the model, and the kurtosis is relatively high, but the test statistics demonstrate that the value is not statistically significant for the kurtosis. The analysis continued by standardized normality probability plot, *pnorm*. The graphical interpretation displays similar properties; some skewness can be observed. Appendices 7 and 8 demonstrate results from the skewness and kurtosis test and *pnorm*-graph. Normality assumption was tested for all the single variables used in the regression model by univariate normality test. Particularly acquirer's and target's turnovers and total assets demonstrated both skewness and kurtosis, but not statistically significantly. Univariate normality test can be observed in Appendix 9. Regression models containing observations with moderate to high amounts of extreme values and skewness may lead to unstable variance (Kaufman 2013, 9). As the data's acquirers and targets varied a lot in size, it further explains the variables' variance. As the final estimation method, the weighted least squares (WLS) method, a particular case of generalized least squares is applied. The WLS model ignores assumptions of heteroskedasticity and the correlation between the variables present in the OLS model. (Kaufman 2013, 51)

4. RESULTS

In this chapter, the results of this thesis are presented, and the hypotheses are answered. After an overview of the development of the medical technology industry M&As, the event study results will be presented following multivariable regression results. In Graph 2, the development of medical technology industry acquisitions is presented. In the graph, yearly values range from 1990 to 2018. The value represents individual values of the transactions ranging from zero to 150 million dollars. The values-axis is cut for better visualization, and in the data are transactions in the 2000s, which exceed the value of 150 million dollars. The circles represent individual acquisitions, and the size of the circle represents acquisition volume in a specific year; the bigger the size of the circle, the more deals were conducted in a specific year.



Graph 2 Development of medical technology acquisitions from 1990 to 2018

From the graphical interpretation, it can be concluded that individual acquisitions' values have increased during the timeline. There are no acquisitions in the early 1990s which exceed the value of 50 million dollars. In the 2000s, acquisitions valuing over 50 million dollars are relatively common, and there are also deals exceeding the value of 100 million dollars. During the timeline, transactions that value between zero and 10 million dollars are constant. After 2003, it can be graphically interpreted that the acquisitions' volume has increased compared to the 1990s and early 2000s. In the years before the 2007 financial crisis, acquisition activity accelerated as the whole economy boomed.

4.1 Event study results

Results from the event study demonstrate that there are statistically significant CAARs around the event date *t*=0. The aggregated time period [-1, +1] demonstrate CAARs of +1.25 percent. During the actual announcement day of an acquisition *t*=0, CAARs of +0.69 percent is observed. After announcement day, in [0, +1] CAARs of +1.23 percent are observed. The aggregated period [-10, -1] demonstrates CAARs of -0.37 percent, indicating that short-term wealth is not created before the acquisitions' announcement day. Other CAARs in the event window are not statistically significant and therefore wealth effects outside the time periods of [-1, +1], [0, 0], [0, +1], and [-10, -1] cannot be evaluated. From the event study results, hypothesis 1*, "Acquirer exhibits positive cumulative average abnormal returns around the announcement day of the acquisition,"* can be fully accepted, as the CAARs around the announcement day are statistically significantly positive. Table 2 presents results from the event study. In the table, *[t1, t2]* is the aggregated period of the CAARs; *CAAR* is the cumulative average abnormal returns in the period *[t1, t2]; Variance* is the variance of the CAARs in the period *[t1, t2]; Z1* is a test statistic in which *CAAR* is divided by the square root of *Variance,* in the period *[t1, t2]; p-value* is the measure of statistical significance, derived from *Z1* statistic.

Table 2 Event study results

[t1, t2]	CAAR (%)	Variance	Z1	p-value
[-10,-1]	**-0,37****	0,0000	-2,0613	**0,0196**
[-5,-1]	-0,37	0,0000	-0,9429	0,1729
[-1,+1]	**1,25*****	0,0000	4,0791	**0,0000**
[0,0]	**0,69*****	0,0000	3,8681	**0,0001**
[0,+1]	**1,23*****	0,0000	4,9168	**0,0000**
[+1,+5]	0,41	0,0000	1,0231	0,1531
[+1,+10]	0,28	0,0000	0,4938	0,3107

(*p<0.1; **p<0.05; ***p<0.01), Obs. 309

4.2 Regression results

Before analyzing the multivariable regression results, an overview of the variables used in the regression is presented. In the summary statistics presented in Table 3, the distinction between variables and imputation variables should be noted. Imputation variables, which were used in the regression model are marked with “I” at the end of the variable name. The imputation meets the “success at an aggregated level”. According to Chambers (2003) this means that the summary statistics with imputation data is close to real-world data. The imputation did not affect much on the variable’s statistics, except the target’s ROE value. Target’s mean ROE shifted from 18 percent to minus four percent, and also, the minimum and maximum values changed drastically. The change in the variable's properties makes imputation values of targets ROEs undependable and should be noted in the regression results. Table 3 presents summary statics of the regression variables.

Table 3 Summary statics of regression variables

Variable	n	Mean	S.D.	Min	Mdn	Max
CAAR	309	0.08	0.08	-0.36	0.00	0.51
ACQRDINT	63	0.06	0.06	0.00	0.05	0.30
ACQRDINTI	309	0.08	0.13	-1.62	0.07	0.30
ACQROE	114	0.16	0.18	-0.49	0.15	0.99
ACQROEI	309	0.14	0.16	-0.49	0.15	0.99
TARGROE	28	0.18	0.37	-0.73	0.25	0.78
TARGROEI	309	-0.04	1.01	-6.60	0.18	8.05
TARGRDINT	6	0.51	0.77	0.02	0.18	2.02
TARGRDINTI	309	0.32	0.52	0.02	0.21	5.91
log_VALUE	167	16.39	2.29	9.21	16.46	23.22
log_VALUEI	309	16.76	2.20	9.21	16.65	23.22
log_ACQTURN	133	19.29	2.48	12.25	19.79	25.10
log_ACQTURNI	309	19.53	2.27	12.25	19.71	25.10
log_TARGTURN	38	15.50	2.31	11.33	15.70	21.58
log_TARGTURNI	309	15.90	1.70	11.33	15.94	21.58
log_ACQASSET	131	19.46	2.61	12.18	19.89	26.31
log_ACQASSETI	309	19.72	2.45	12.18	19.95	26.31
log_TARGASSET	41	15.83	2.24	10.38	15.97	23.18
log_TARGASSETI	309	15.94	1.68	10.38	15.62	23.18

The results from the original data regression and imputation-variable regression are presented in Tables 4 and 5, respectively. The imputation regression model's coefficient of determination is 0.77, and thus, the chosen variables explain the variance of the CAARs on an adequate level. The original data regression model's coefficient of determination is 0.21. Differences in the coefficient of determination demonstrate that the imputation and additional variables resulted in a better explanation of the variables. Imputation regression results demonstrate that the acquirer's R&D intensity positively correlates with the CAARs. A percent increase in acquirer's R&D intensity increases CAARs by 8.61 percent, holding all of the other variables constant. Contradictorily, the original value regression

demonstrates a negative relationship between the acquirer's R&D intensity and the CAARs. According to the regression with original data, a percent increase in acquirer's R&D intensity decreases CAARs by 45.52 percent, holding all of the other variables' constant. Thus, hypothesis 2a," *Acquirer's absorptive capacity increases its short-term post-acquisition performance,"* is rejected. The results from the imputation regression demonstrate that the target's R&D intensity positively correlates with the CAARs. A percent increase in target's R&D intensity increases CAARs by 5.57 percent, holding all the other variables constant. Target's R&D intensity was highly imputed and thus made this result uncertain. Hypothesis 2b, *"Target's innovativeness increases the acquirer's short-term post-acquisition performance,"* is rejected. The proper relationship cannot be determined from the existing imputation-only data available. The relationship between industry relatedness and CAARs does not demonstrate a statistical significance in the imputation nor the original data regression. Thus, hypothesis 3, "*Industry relatedness between the acquirer and target firms increases the acquirer's short-term post-acquisition performance,"* is rejected.

Results from indicator variables in the imputation regression demonstrate that the target's turnover is negatively correlated with CAARs. A percent increase in target's turnover decreases CAARs by 0.0019 percent. Target's total assets and ROE are positively correlated with CAARs. A percent increase in target's total asset and ROE increases CAARs by 0.0054 and 5.65 percent, respectively. Acquirer's ROE has a negative relationship with CAARs. A percent increase in acquirer's ROE decreases CAARs by 3.67 percent. M&A experience shows a negative relationship with CAARs. Acquirer with previous M&A experience decreases CAARs by 0.96 percent. The original data regression does not show a significant relationship between M&A experience and CAARs. Acquisition year is positively correlated with CAARs in the imputation and original data regressions. The one-year increase during the timeline from 1990 to 2018 increases the CAARs by 0.07 percent (imputation model) and 0.51 percent (original data model). Acquirer's turnover and total assets demonstrate an insignificant relationship with CAARs. The value of the transaction does not show a significant relationship with CAARs in both models.

Table 4 Multivariable regression model results without imputation variables

Dependent variable = CAAR

ACQRDINTI	**-0.4552****
	(0,036)
INDUSTRELAT	-0,1951
	(0,498)
log_ACQTURN	-0,0106
	(0,104)
log_VALUE	-0,0005
	(0,943)
MAEXP	-0,0307
	(0,170)
YEAR	**0,0051****
	(0,049)
CONST.	-0,1864
	(0,221)

(*p<0.1; **p<0.05; ***p<0.01)

Obs.	41
R^2	0,21
F(6,34)	1,52
	(0,2021)

Table 5 Multivariable regression model results with imputation variables

Dependent variable = CAAR

ACQRDINTI	**0,0861****	ACQROEI	**-0,0367****
	(0,013)		(0,0170)
INDUSTRELAT	0,0066	TARGROEI	**0,0565*****
	(0,3320)		(0,0000)
TARGRDINTI	**0,0557*****	log_VALUEI	-0,0010
	(0,0000)		(0,3980)
log_ACQTURNI	0,0000	MAEXP	**-0,0096***
	(0,9910)		(0,0580)
log_TARGTURNI	**-0,0043****	YEAR	**0,0007***
	(0,0480)		(0,0530)
log_ACQASSETI	-0,0034	CONST.	**-0,0778****
	(0,2460)		(0,0180)
log_TARGASSETI	**0,0127*****		
	(0,0000)		

(*p<0.1; **p<0.05; ***p<0.01)

Obs.	309
R²	0,77
F(12,95)	83,93***
	(0,0000)

5. DISCUSSION

This thesis first introduced the current state of M&A studies and gave an aim and scope for this study. In the second chapter, previous short-term return study results were presented. Also, absorptive capacity, strategic fit, and industry relatedness theories were presented. Methodologies chapter presented the event study for estimating the short-term returns and a multivariable regression model for estimating the impacts of R&D intensity and industry relatedness. Results of this thesis were presented in the fourth chapter.

The cumulative average abnormal returns of +1.25 percent observed in the period [-1, +1] demonstrate that the acquisitions are value-creating in the short-term. The regression model further explained which characteristics of the deal participants had a positive effect on the CAARs. The level of acquirer's R&D intensity did not demonstrate a clear relationship with the CAARs, as the imputation and non-imputation model demonstrated differing results. Thus, this thesis did not give more results to King et al. (2020). The results did not support Miyazaki's (2009, 201) findings that there is a correlation between R&D investment and high-technology M&As. This thesis did not find support for Duflos and Pfister (2008), who demonstrated that the acquirer with greater prior R&D intensity might absorb knowledge more effectively from the target, thus further explaining the importance of the acquirer's R&D intensity on the short-term wealth creation. Table 3 demonstrates that the target's mean R&D intensity, 51 percent, is relatively high compared to the acquirer's 8 percent, suggesting that medical technology acquisitions may be motivated by enhancing the acquirer's R&D pipeline. It cannot be concluded whether the acquirer's absorptive capacity has a positive effect on the short-term abnormal returns. Therefore, there is no conclusion found in this thesis for the main research question, *"When do high-technology acquisitions lead to positive abnormal returns?"*

This thesis's results are aligned with previous short-term return studies and provide evidence that short-term returns during the announcement of an acquisition may be positive

for the acquirer. These cumulative average abnormal returns demonstrate that short-term wealth is created for the acquirer's shareholders, and the strong form-market hypothesis can be rejected. The market favors the news of medical technology acquisition. Campa and Hernando (2004) demonstrated CAARs of +0.61 percent for an acquirer in acquisitions inside the EU in the period [-1, +1]. Compared to the result obtained from this thesis in the same period (CAARs of +1.25), it may be that medical technology acquisitions create higher short-term returns for the acquirer compared to mixed-industry acquisitions inside the EU. This implication would need more evidence to be proven correct. Acquirer's CAARs are more substantial as the years progressed from 1990 to 2018. Increasing CAARs during the timeline may indicate that medical technology acquisitions began to be more value-creating for the acquirers' shareholders. This may be due to several factors, including the overall development of the economy, and thus it cannot be adequately evaluated. The CAARs of -0,37 percent in the period [-10, -1] indicate that value is not created for the acquirer's shareholders before the acquisition announcement. It may also indicate that there is no leakage of information before the announcement day, and thus the investor's expectations of the acquirer's future profits do not change.

This thesis did not support Alhenawi and Stilwell's (2019) findings, in which related acquisitions in high-technology are value-creating. The industry-relatedness of the acquirer to the target did not have a statistically significant relationship. In the sample, 264 acquisitions were industry-related, and 45 acquisitions were non-industry-related. Data disparity may affect the results, as the number of non-industry-related acquisitions in the sample was relatively low. Thus, this observation gives qualitative information about medical technology acquisitions; industry-related acquisitions are more common than non-related ones.

The control variables demonstrated that the target's turnover was negatively correlated with CAARs. Target's assets and ROE positively correlated with CAARs. The market may favor the target's profitability and size compared to turnover. This implication needs more support, as the target's ROE was a high imputation variable. Acquirer's ROE has a

negative relationship with CAARs. The negative relationship may be due to managerial hubris; profitable firms may participate in value-eroding acquisitions, and thus the ROE of the acquirer demonstrates a negative relationship with the short-term returns. Moreover, M&A experience demonstrated a negative relationship with CAARs. This thesis' findings do not support Kirchhoff and Schiereck (2011), who demonstrated the opposite relationship. Prior M&A experience does not result in higher short-term returns for the acquirer in the medical technologies industry. It may be that learning from past M&As does not implicate greater short-term returns and the amount of past M&As prone the management to hubris.

Graph 2 supports Gregoriou and Renneboog's (2007, 1-2) findings, who stated that the modern sixth wave of M&As might have begun from 2003. After 2003, it can be graphically interpreted that the volume of acquisitions has increased compared to the 1990s and early 2000s. During the timeline between 1990 and 2018, the acquisition values progressed to deals exceeding 150 million dollars. The volume of acquisitions valuing under 10 million dollars has stayed constant. As small-to-medium size firms dominate the medical technology market, it may explain the constant lower value deals. Transaction costs for the acquirer are relatively low as the target's value is not high. The volume and value of the acquisitions have risen over time. It is dubious how the new EU regulations 2017/745 and 2017/746 will affect these attributes of medical technologies M&As. It may seem likely that the regulation's effects will reduce the patent process's speed, and the targets may face higher R&D expenses. In that case, the target's R&D intensiveness is higher in the future. The higher R&D intensiveness of the targets may not enhance the acquirer's short-term wealth effects as it does not account for any additional innovation. If the overall technological development is perceived perpetual, medical technology M&A volumes may continue relatively stagnant, as new technology innovation created in small-to-medium size firms is acquired.

5.1 Limitations, managerial implications, and future research

The major limitation of this thesis was the partial usage of imputation variables in the regression model. The imputation makes the assumptions of the validity of the model used questionable as the real-world data may hold different attributes. Imputation variables enabled the usage of larger amounts of observations, and the data's descriptive statistical properties did not change drastically for the majority of the variables used. An additional regression model with real data and fewer variables and observations were conducted for additional robustness. This thesis was limited to acquisitions inside the European Union from years 1990 to 2017. This limitation does not control the geographical location, and study results may differ in different locations. The 28-year timespan used in this thesis may affect the outcome as it holds at least two different M&A waves within, and the model may contain some autocorrelation. Also, the financial crisis may have affected the studied abnormal returns. Besides the data used, the used methodology may have had different kinds of effects on the results. If different estimation methods besides the CAPM were applied in the event study, the results could have been more robust.

The managerial implications deriving from this thesis are the following. Firstly, the acquirer management should expect that its investors react positively to the announcement of an acquisition. This is an advantage for the acquiring firm's management, as the shareholders may be more flexible if the settlement of the deals' terms outlasts, as it commonly does. Shareholders anticipate that the deal is valuable, and thus, the outlast is acceptable, and the deal completion is unobstructed. Secondly, the management from a different industry should not shy from a medical technology acquisition. This thesis did not find a significant relationship between the industry-related and non-related acquisition in short-term wealth creation. The acquisitions' consideration should focus on evaluating how well the target firm strategically fits with the current firm. The medical technology market has provided stable value in the past years, and thus non-medical technology acquirers might consider the acquisition if the fit is right. Target firm management should anticipate tender offers from larger firms. Target's management should focus on the acquisition's possible

strategic fit and consider how effectively the target can provide and transfer knowledge for the acquirer.

This thesis did not study the different CAARs for industry-related and unrelated acquisitions. Moreover, this thesis did not find a significant relationship between industry-related acquisitions and short-term abnormal returns. Future scholars could provide more evidence on the effects of the acquirer's industry relatedness to the target in short-term abnormal returns for the acquirer. Future research could study medical technology M&As in different geographical locations, for example, in the US, to provide more insights from a rather unresearched industry. The following studies should use real-world data to study the acquirer's and target's R&D intensities to explain the absorptive capacity's impact on the short-term returns.

Furthermore, absorptive capacity and strategic fit theories are continually evolving, and thus they have been applied in several different models and situations in finance, organizational sciences, and economics. This thesis used these theories to explain the short-term wealth effects for the acquirer in an acquisition. In the present condition, the theories should be revisited in the pursuance of creating a more specific theoretical model to evaluate the effects of these attributes on the acquisition success. More robust quantitative evaluation methods on the M&A participant's strategic fit and the ability to absorb knowledge from the other participant should be built. As stated in The Economist (1999, 15), the acquirer's management should focus on the ''marriage, not the wedding.'' The post-acquisition integration is critical in the success of an M&A. Thus, absorptive capacity and strategic fit should be evaluated before the ''wedding'' or the announcement of the acquisition.

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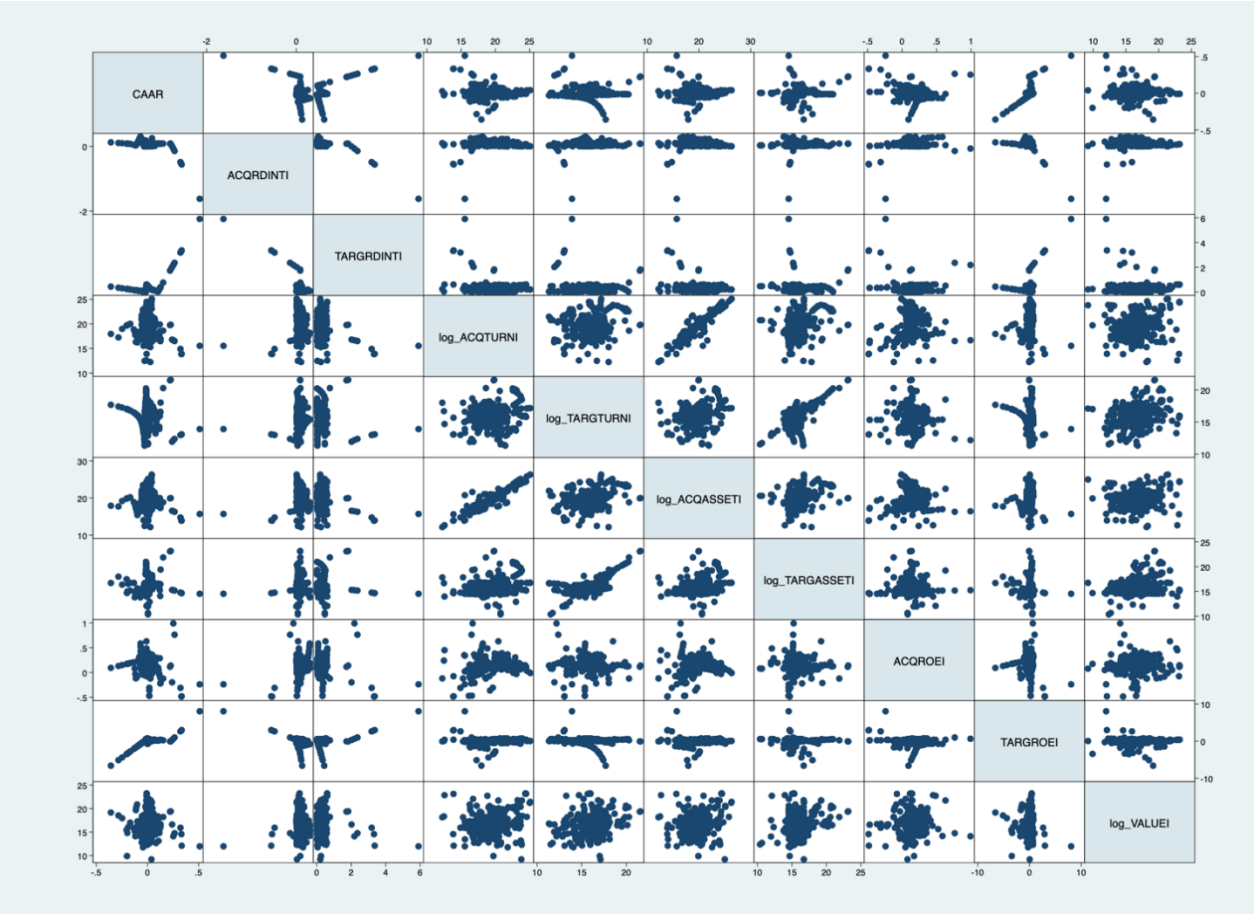
APPENDICES

APPENDIX 1: LIST OF SIC CODES

SIC - code	Title
2835	In Vitro and In Vivo Diagnostic Substances
3842	Orthopedic, Prosthetic, and Surgical Appliances and Supplies
3845	Electromedical and Electrotherapeutic Apparatus
3844	X-Ray Apparatus and Tubes and Related Irradiation Apparatus
3829	Measuring and Controlling Devices, Not Elsewhere Classified
3841	Surgical and Medical Instruments and Apparatus
3069	Fabricated Rubber Products, Not Elsewhere Classified
3089	Plastics Products, Not Elsewhere Classified
3821	Laboratory Apparatus and Furniture
3851	Ophthalmic Goods
3843	Dental Equipment and Supplies
3851	Ophthalmic Goods
5995	Optical Goods Stores

APPENDIX 2: CORRELATION MATRIX



APPENDIX 3: PAIRWISE CORRELATION

	CAAR	ACQRDI~I	TARGRD~I	log_A~NI	log_T~NI	log_A~TI	log_T~TI
CAAR	1.0000						
ACQRDINTI	-0.5942	1.0000					
	0.0000						
TARGRDINTI	0.6434	-0.8258	1.0000				
	0.0000	0.0000					
log_ACQTURNI	-0.0999	0.0354	-0.1830	1.0000			
	0.0796	0.5353	0.0012				
log_TARGTU~I	-0.0328	0.1141	-0.1053	0.2115	1.0000		
	0.5663	0.0451	0.0646	0.0002			
log_ACQASS~I	-0.0925	0.0316	-0.1785	0.9371	0.2930	1.0000	
	0.1046	0.5804	0.0016	0.0000	0.0000		
log_TARGAS~I	0.1458	0.0030	-0.0232	0.2393	0.7512	0.2735	1.0000
	0.0104	0.9585	0.6849	0.0000	0.0000	0.0000	
ACQROEI	-0.1875	0.2599	-0.1669	0.1946	-0.0233	0.1288	-0.0064
	0.0009	0.0000	0.0033	0.0006	0.6827	0.0235	0.9115
TARGROEI	0.8086	-0.5924	0.5289	0.0471	-0.1135	0.0595	-0.0044
	0.0000	0.0000	0.0000	0.4091	0.0461	0.2969	0.9394
log_VALUEI	-0.0577	0.0869	-0.1009	0.1548	0.2640	0.2149	0.2869
	0.3119	0.1273	0.0767	0.0064	0.0000	0.0001	0.0000

	ACQROEI	TARGROEI	log_VA~I
ACQROEI	1.0000		
TARGROEI	-0.1151	1.0000	
	0.0431		
log_VALUEI	0.0220	-0.0456	1.0000
	0.7000	0.4245	

APPENDIX 4: VIF-TEST

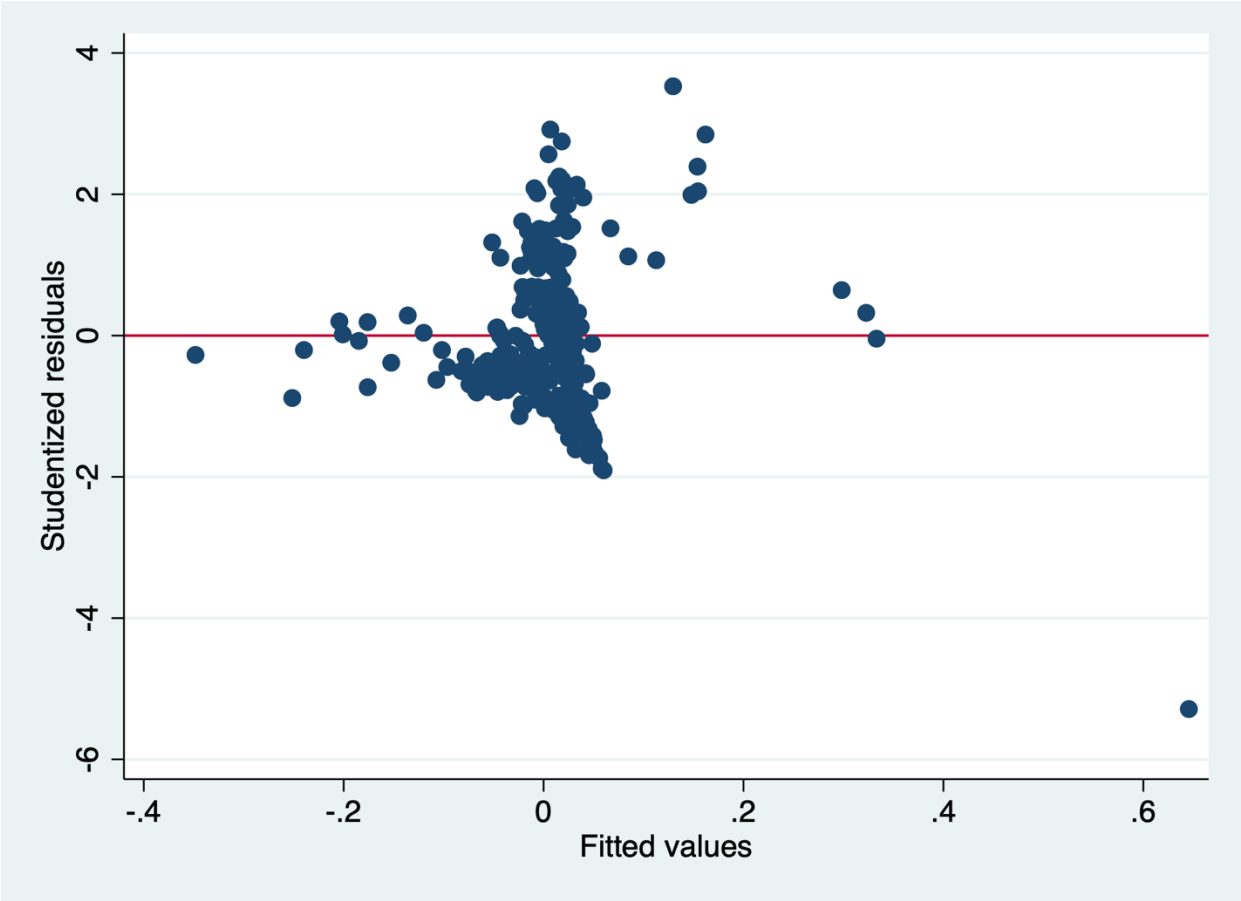
Variable	VIF	1/VIF
log_ACQASS~I	9.68	0.103253
log_ACQTURNI	9.40	0.106349
ACQRDINTI	4.10	0.243863
TARGRDINTI	3.66	0.273104
log_TARGTU~I	2.60	0.384283
log_TARGAS~I	2.47	0.404303
TARGROEI	1.62	0.616293
log_VALUEI	1.21	0.829761
ACQROEI	1.18	0.848014
MAEXP	1.18	0.848886
YEAR	1.12	0.895203
INDUSTRELAT	1.10	0.908167
Mean VIF	3.28	

APPENDIX 5: BREUSCH-PAGAN TEST

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of CAAR

         chi2(1)      =    66.47
         Prob > chi2  =   0.0000
```

APPENDIX 6: TWO-WAY SCATTER OF RESIDUALS AND PREDICTED Y



APPENDIX 7: SKEWNESS AND KURTOSIS TEST

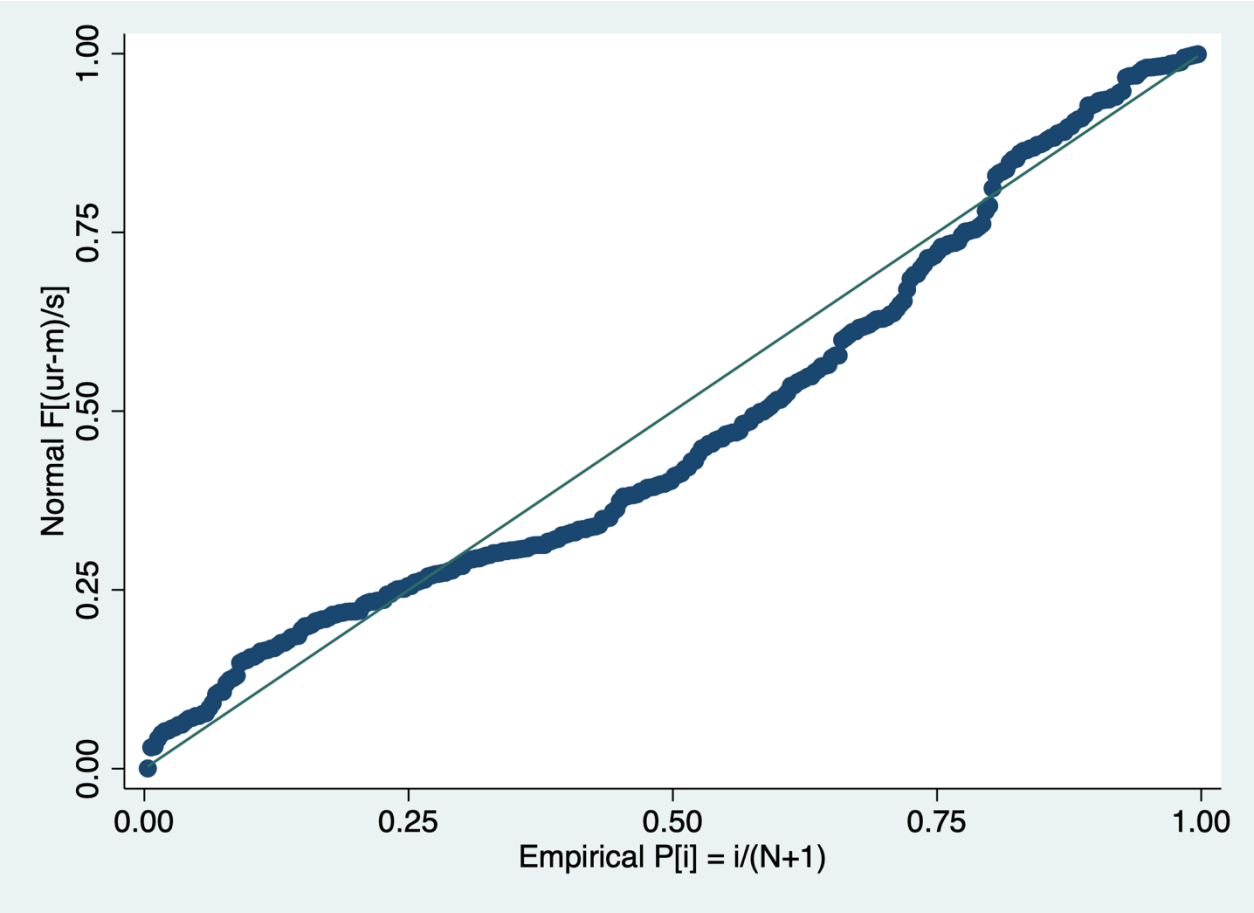
Residuals

	Percentiles	Smallest		
1%	-.0676004	-.1344464		
5%	-.0565894	-.0736092		
10%	-.039542	-.072903	Obs	308
25%	-.0256981	-.0676004	Sum of Wgt.	308
50%	-.0093074		Mean	-1.14e-10
		Largest	Std. Dev.	.0390834
75%	.0228163	.1028751		
90%	.0576057	.1066589	Variance	.0015275
95%	.0805523	.1139264	Skewness	.5999503
99%	.1028751	.1230641	Kurtosis	3.411594

Skewness and kurtosis tests for normality

				Joint test	
Variable	Obs	Pr(skewness)	Pr(kurtosis)	Adj chi2(2)	Prob>chi2
ur	308	0.0000	0.1389	16.05	0.0003

APPENDIX 8: PNORM GRAPH



APPENDIX 9: UNIVARIATE NORMALITY TEST FOR SINGLE VARIABLES

Test for univariate normality

Variable	Pr(Skewness)	Pr(Kurtosis)	adj chi2(2)	joint Prob>chi2
CAAR	0.0000	0.0000	74.86	0.0000
ACQRDINTI	0.0000	0.0000	331.03	0.0000
TARGRDINTI	0.0000	0.0000	294.91	0.0000
log_ACQTURNI	0.4789	0.2744	1.71	0.4260
log_TARGTU~I	0.6024	0.0278	5.14	0.0767
log_ACQASS~I	0.9122	0.2678	1.25	0.5356
log_TARGAS~I	0.0000	0.0000	54.18	0.0000
ACQROEI	0.2061	0.0000	35.84	0.0000
TARGROEI	0.0034	0.0000	79.68	0.0000
log_VALUEI	0.0971	0.0044	9.83	0.0073