A Work Project presented as part of the requirements for the award of a Master's degree in Economics / Finance / Management from the Nova School of Business and Economics.

# SUCCESS FACTORS OF M&A: THE EFFECT OF COMPLEMENTARITIES BETWEEN ACQUIRING AND TARGET FIRM IN THE PHARMACEUTICAL AND BIOTECHNOLOGICAL INDUSTRY

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04-01-2021

**Abstract**

Recent literature on success factors of mergers and acquisitions investigated the role of strategic fit and complementarities to assess an acquisition's value creation potential. Whereas many studies focus on certain acquisition strategies and their respective relevant firm characteristics, it may be important to consider the performance implications of different acquisition types. This study investigates how complementarities involved in different acquisition types affect acquisition performance in the pharmaceutical and biotechnological industry. The findings suggest that product-extension acquisitions create more value for acquiring firms than other acquisition types, namely vertical, horizontal, market-extension, and unrelated acquisitions.

*Keywords:* M&A success, complementarity, acquisition types, acquisition experience

This work used infrastructure and resources funded by Fundação para a Ciência e a Tecnologia (UID/ECO/00124/2013, UID/ECO/00124/2019 and Social Sciences DataLab, Project 22209), POR Lisboa (LISBOA-01-0145-FEDER-007722 and Social Sciences DataLab, Project 22209) and POR Norte (Social Sciences DataLab, Project 22209).

## 1. Introduction

Mergers and acquisitions are an important topic in academic research and are examined from various perspectives and at different stages, from antecedents of acquisition decisions, success factors of acquisitions, and potential firm-specific or environmental outcomes of acquisitions (Haleblian et al., 2009). Acquisitions bear substantial risks to the acquiring firm, and prior M&A literature did not provide consistent evidence supporting that M&A activities benefit the acquiring firm (Cartwright & Schoenberg, 2006; Steigenberger, 2017). A large part of the M&A literature examined characteristics and contextual aspects that inhibit or promote M&A success (Ferreira et al., 2014; Haleblian et al., 2009; Cartwright & Schoenberg, 2006). One of the focus topics in strategic management literature on M&A is the influence of firm characteristics on M&A performance, especially the influence of similarities and complementarities between target and acquiring firms (Bauer & Matzler, 2014). This study examines the effect of strategic fit in the context of the pharmaceutical and biotechnological industry. Particularly, since firms in this industry context pursue various acquisition motives, this study compares different types of acquisitions based on their potential for complementarities. Therefore, this study examines the following research question:

*"How do the complementarities between acquiring and target firm affect M&A success in the biotechnology and pharmaceutical industry?*

To answer this research question, relevant prior literature on success factors of M&A, with a focus on strategic management and organizational learning research, is reviewed in the following section, and hypotheses for the pharmaceutical and biotechnological industry are developed. Subsequently, this study's methodology for hypotheses testing is determined, and statistical results will are presented. Lastly, the theoretical findings are discussed, and managerial implications are interpreted.

## 2. Literature review and hypotheses development

### 2.1. Value creation in M&A and firm characteristics

In M&A literature, value creation is viewed as the primary motive for firms to engage in M&A activity (Seth et al., 2000; Haleblian et al., 2009). Although evidence of prior literature indicates that acquisitions in many industries do not, on average, create value for the acquiring firm, research on M&A success factors examines conditions and characteristics of acquisitions that facilitate value creation. To assess an acquisition's value creation potential, research on success factors considers the strategic fit between target and acquiring firm to be essential (Cartwright & Schoenberg, 2006). Acquisition literature commonly used the firm's resource-based view to explain the concept of strategic fit and the value creation mechanisms of M&A (Ferreira et al., 2014). According to the resource-based view, differences between firms and their performance can be explained by each firm's unique resource allocation and capabilities (Barney et al., 2011; Barney, 1991). Resources include both tangible and intangible assets of a firm, such as production machinery, facilities, patents, brand image, and knowledge, whereas capabilities describe organizational processes applied to accomplish certain objectives (Helfat & Peteraf, 2003; Maritan & Peteraf, 2011). Firms utilize acquisitions to combine resources with target firms to achieve strategic goals and create value for the acquiring firm (Seth et al., 2000; Wang & Zajac, 2007; Haleblian et al., 2009). Thus, M&A value creation opportunities are dependent on the fit of the characteristics and capabilities between the target and acquiring firm (Kim & Finkelstein, 2009; King et al., 2004).

Prior strategic management literature debated elaborately on whether similar or complementary characteristics and capabilities facilitate value creation for acquirers (Wang & Zajac, 2007). In the relatedness literature, it is argued that firms acquiring similar firms can create more value because they could benefit from increased market power, economies of scale, and economies of scope (Seth, 1990). Since target and acquirer operate in the same industry and compete for

the same markets, their market position is expected to be strengthened after the acquisition, and their ability to bargain for preferential prices is increased. Similar firms may also benefit from economies of scale because they can combine production, reduce overhead redundancies, and increase bargaining power with suppliers or distributors (Wang & Zajac, 2007). Additionally, similar firms could benefit from economies of scope, such as using excess capacities production or distribution and exploiting previously underused assets in research and development or marketing. However, past studies did not generate consistent support for the value creation through similarities in target and acquiring firms (King et al., 2004; Harrison et al., 1991).

In contrast to the relatedness literature, Harrison et al. (1991) reasoned that firms with different resource allocations have greater potential to enable value-creating synergies because they offer access to distinct value creation opportunities for the acquiring firm, which cannot be exploited by other bidding firms. In a study of 1,100 acquisitions, Harrison et al. (1991) examined differences in resource allocations between acquiring and target firms and found supporting evidence, suggesting that differences in resource allocations create value for the combined firm. The results of Tanriverdi and Venkatraman (2005) support this notion, suggesting that complementarity in three knowledge domains, namely product, customer, and market knowledge leads to increased financial performance as well as market performance, while relatedness does not improve performance. Adding to these findings, recent strategic management studies provide consistent evidence supporting the positive effect of firm complementarity on M&A performance (Bauer & Matzler, 2014; King et al., 2008; Kim & Finkelstein, 2009; Makri et al., 2010). According to Wang and Zajac (2007), complementarities exist when firms' distinct resources or capabilities are interrelated and support each other. Similarly, Kim and Finkelstein (2009) define complementarity in the context of acquisitions as a potential for combining target and acquiring firm resources to create additional value. From a resource-based perspective, merging firms with complementary resources can benefit from

combining them and realizing synergies (King et al., 2008). Thus, acquisitions between highly complementary firms are expected to have a high potential for value creation opportunities (Bauer & Matzler, 2014). In contrast, inconsistent evidence for a positive effect of target and acquirer similarity may be explained by a greater risk of resource redundancies due to negative substitution effects between similar target and acquirer resources.

Another common argument for value creation through complementarities is that the acquiring firm enters a bidding process for the target firm, which usually leads to acquirers paying substantial premiums for target firms (Haleblian et al., 2009; Capron & Pistre, 2002; Harrison et al., 1991; Barney, 1988). In contrast to acquisitions of similar targets, researchers on complementarities argue that acquirers with different resource allocations expect unique synergies and thus may assess target values very differently (Maritan & Peteraf, 2011). These heterogeneous valuations of targets allow complementary acquirers to capture value in the bidding process.

### 2.2. Context and M&A types

In order to understand the mechanisms and success factors of M&A, it is critical to consider the context and type of acquisition. Depending on the industry context, firms pursue acquisitions for very different reasons. For example, the U.S. banking industry experienced many horizontal acquisitions over the past decades, with firms seeking to increase their market power and to gain scale efficiencies (Kim & Finkelstein, 2009). On the other hand, in high-tech industries, technology-focused acquisitions are very common (King et al., 2008). This study will explore the success factors of acquisitions in the pharmaceutical and biotechnological industry. Like many other industries, this industry faced ongoing consolidation over the past decades (Kirschoff & Schiereck, 2011; Sorescu et al., 2003). However, pharmaceutical and biotechnological firms pursue various acquisition strategies, from purely horizontal to technology-focused or marketing-focused acquisitions.

The variations in acquisition strategies need to be considered to determine the strategic fit between target and acquiring firms. Numerous studies apply the Federal Trade Comission (FTC) acquisition typology to differentiate between acquisition strategies, arranging acquisitions into five types: vertical, horizontal, market-extension, product-extension, and unrelated/conglomerate (Hopkins, 1987; Seth, 1990). Acquisitions between firms on different levels of the value chain, which could enter a supplier-buyer relation, are termed vertical acquisitions. On the other hand, acquisitions between firms on the same level of the value chain, competing in the same markets and same product categories, are labeled horizontal. Market-extension acquisitions refer to acquisitions between target and acquiring firms that operate in the same product categories but distribute to different geographic markets. Conversely, product-extension acquisitions refer to acquisitions between companies on similar levels of the value chain that operate in different product categories. Lastly, unrelated or conglomerate acquisitions include acquisitions between fundamentally unrelated acquiring and target firms (Fan & Goyal, 2006; Seth, 1990).

## 3. Hypotheses Development

Based on the review of previous literature, this study focuses on the following four aspects of acquisitions in the pharmaceutical and biotechnological industry: (1) value chain position of target and acquirer, (2) product complementarity, (3) market complementarity, (4) acquisition capabilities. The focus on these four aspects and their hypothesized relationships with acquisition performance are outlined below.

### 3.1. Vertical acquisitions

It could be argued that vertical acquisitions may lead to greater value creation than other acquisition types for acquiring firms in the pharmaceutical and biotechnological industry. From a resource perspective, it can be argued that acquisitions on different levels of the value chain involve firms with very different yet complementary sets of resources and capabilities (Harrison

et al., 1991). As King et al. (2008) examined in a study of technological acquisitions in high-tech industries, combinations of more distinct competencies between marketing-focused acquirers and R&D-focused targets created additional value for the acquirer. In contrast, acquirer R&D and target R&D resources exerted a negative interaction effect on M&A performance. Another argument for higher performance of vertical acquisitions would be to increase efficiency and reduce transaction costs of processes that could be better coordinated within one organization. By integrating a supplier or distributor and internalizing its complementary capabilities, a pharmaceutical manufacturer could align processes to increase efficiency and save transaction costs (Fan & Goyal, 2006; Kedia et al., 2011). Thus, vertical acquisitions may offer more opportunities for creating synergies than acquisitions of firms on similar value chain levels, which may experience greater resource redundancies with the acquirer. Based on these arguments, this study hypothesizes the following relationship between vertical acquisitions and acquisition performance:

*Hypothesis 1: Vertical acquisitions exhibit greater acquisition performance than other acquisition types (horizontal, product-extension, market-extension, or unrelated acquisitions).*

### 3.2. Product-extension acquisitions

Another view is that complementarity in product-extension acquisitions may be most beneficial to the acquiring firms. In comparison to horizontal acquisitions of similar firms, which may increase the risks of resource substitution (King et al., 2008), complementarity in product categories may enable firms to exploit both efficiency-based and enhancement-based synergies. In line with this argument, Kim & Finkelstein (2009) found evidence for horizontal acquisitions in the banking industry, supporting that complementarity in product portfolios enhances acquirer stock returns. Although firms in the pharmaceutical and biotechnological industry may serve more heterogenous product market categories, such as over-the-counter drugs, surgical products, and therapeutic products, firms operating in different product categories could still

exploit potential efficiency-based synergies. For example, pharmaceutical manufacturers operating in distinct product categories could still depend on similar inputs, such as chemical or biological raw materials and R&D, maintain similar potentially redundant overhead functions, use similar distribution channels, and cater to overlapping customer segments. Moreover, product-extension acquisitions may offer opportunities for enhancement-based synergies to the acquirer, introducing target products to existing acquirer markets or combining product offerings. Therefore, the following association between product-extension acquisitions and acquisition performance is expected:

*Hypothesis 2: Product-extension acquisitions exhibit greater acquisition performance than other acquisition types.*

### 3.3. Market complementarity

Prior research argued that market fit is another dimension on which acquirers benefit from complementarities with their target firms (Bauer & Matzler, 2014; Harrison et al., 1991). One common motive for firms to acquire target firms on a similar value chain level is to improve their combined market position. Zollo and Singh (2004) compare horizontal acquisitions and market-extension acquisitions in the banking industry and argue that acquisitions between firms in similar geographic markets should perform better than firms in unrelated markets. They were unable to obtain significant evidence for their hypotheses, arguing that value-enhancing synergies of acquisitions in complementary markets may counteract efficiency-based synergies of acquisitions in related markets. Building on Zollo and Singh's (2004) findings, Kim and Finkelstein propose that complementarity between the target and acquiring firm's geographic markets enhances acquisition performance and finds significant evidence for their hypothesis.

In line with these findings, this study argues that firms in the pharmaceutical and biotechnological industry benefit from acquiring target firms with complementary geographic markets. On the one hand, acquirers may gain access to the target firm's complementary markets

or leverage reach to existing markets, introducing target firm products, which realizes revenue-enhancing synergies. On the other hand, by having more options to reach different segments in combined geographic markets, the acquirer could increase profitability by focusing on the most profitable markets. Thus, this study hypothesizes the following effect of market complementarity on acquisition performance:

*Hypothesis 3: For acquisitions of target firms on similar levels of the value chain (horizontal, product-extension, or market-extension acquisitions), market complementarity is positively associated with acquisition performance.*

### 3.4. Acquirers' acquisition experience

In more recent strategic management literature, several researchers added aspects of the organizational learning literature to the strategic fit perspective, arguing that M&A performance is not only determined by pre-acquisition aspects but also by post-acquisition processes (Bauer & Matzler, 2014; Zaheer et al., 2013; Steigenberger, 2017; Cartwright & Schoenberg, 2006). In particular, acquisition experience has been regarded as an important attribute of acquisition capabilities because it may enable a firm's managers to coordinate the acquisition process more efficiently (Wang & Zajac, 2007). Nevertheless, existing studies on acquisition experience provide mixed results for the effect of acquisition experience on acquisition performance (Zollo & Singh, 2004; King et al., 2004; Haleblian & Finkelstein, 1999). Thus, the assumed association between acquisition experience and M&A performance may be more complex and dependent on several other acquisition attributes (King et al., 2004). In a more recent study, Kaul & Wu (2016) argued that acquisition capabilities are more valuable if acquisition targets are less familiar to the acquirer and require more complex integration.

To benefit from synergies created through complementarities with their target firms, acquirers may require certain abilities to capture this potential during the integration phase (Wang & Zajac, 2007; Kim & Finkelstein, 2009). Experienced acquirers may be able to leverage their

knowledge to make better decisions during the acquisition process and integration, avoiding potential mistakes. Furthermore, experienced acquirers may have built up the necessary capabilities to facilitate more efficient and effective resource redeployment in order to exploit synergy potentials (Bauer & Matzler, 2014). In line with this argument, Kim & Finkelstein (2009) provide supporting evidence that firms with experience in acquiring firms outside of their markets benefit more from target companies with complementary markets than inexperienced acquirers. Therefore, this study anticipates a positive interaction effect of acquisition experience and the above-considered associations with acquisition performance:

*Hypothesis 4a: Acquirer's acquisition experience exerts a positive interaction effect on the association between vertical acquisitions and acquisition performance.*

*Hypothesis 4b: Acquirer's acquisition experience exerts a positive interaction effect on the association between product-extension acquisitions and acquisition performance.*

*Hypothesis 4c: Acquirer's acquisition experience exerts a positive interaction effect on the association between market complementarity and acquisition performance.*

## 4. Method

### 4.1. Sample

The data on M&A transactions is obtained from the Thomson Reuters SDC database, which provides deal announcements, involved companies with identifiers, company descriptions, and deal types. The transaction observations from the SDC database are filtered for several requirements. First, this study considers mergers and acquisitions between 2004 and 2020. This period offered a sufficient number of transactions with the required data for the pharmaceutical and biotechnological industry. Second, to measure acquisition performance using stock information, only deals with public acquiring firms are considered. Third, to filter out any other investment decisions, only mergers, majority interest acquisitions, and acquisitions of assets are considered (Frésard et al., 2020). Fourth, since acquisition databases also contain many

acquisition attempts that could not provide insights on acquisition performance, only completed deals are examined.

Financial and fundamental company data for the control variables, such as total assets, employee numbers, and industry classifications, are retrieved from Compustat Global, -North America, and Factset Revere. Unique company identifiers (CUSIP codes) are used to merge the datasets available in all three databases. Consequently, only the transactions for which both the acquiring and the target firm could be matched via CUSIP codes are considered. To identify transactions within the pharmaceutical and biotechnological industry, the North American Industry Classification System (NAICS) is used. Similar to Kelton et al. (2008), the pharmaceutical and biotechnological industry is defined by the following NACIS codes: *Pharmaceutical and Medicine Manufacturing* (3254), *Electromedical and Electrotherapeutic Apparatus Manufacturing* (334510), *Surgical and Medical Instrument Manufacturing* (339112), *Surgical Appliance and Supplies Manufacturing* (339113), and *Scientific Research and Development Services* (5417). Only deals in which either the acquirer's or the target's NAICS code belongs to this industry cluster are included. Thereby, 484 transactions are identified.

Finally, necessary data for the dependent, independent, and control variables are added and checked for missing data. Stock data of the acquiring companies, required to calculate the dependent variable, is retrieved from the Research on Security Prices database (CRSP). Data on both acquirer's and target's geographical sales distribution for the independent variable, market complementarity, is obtained from Factset GeoRev and Compustat Historical Segments. Due to the limited availability of data, especially for data on geographical sales distribution, the sample is further reduced. The final dataset contains 104 different observations (mergers and acquisitions). These deals can be divided into three subsegments, 26 vertical acquisitions, 48 horizontal and market-expansion acquisitions, 27 product-extension acquisitions, and three

unrelated acquisitions. Hypothesis 1, 2, 4a, and 4b will be tested on the full sample of 104. Since Hypothesis 3 and 4c only examine acquisitions between firms on similar levels of the value chain, namely product-extension, market-extension, and horizontal acquisitions, other acquisition types will be filtered out, creating a sub-sample of 75 acquisitions.

### 4.2. Dependent variable

The measurement of acquisition performance is an extensively discussed topic in research on firm acquisitions. In quantitative studies, two main approaches are generally used: Event studies using stock information and studies relying on accounting-based measures (Haleblian et al., 2009). Depending on the context and subject of a study, accounting-based measures can provide only limited insights into an acquisition's performance because the overall financial results of a company are usually affected by a variety of other factors than acquisitions. Several researchers hold that cumulative abnormal returns (CAR) are the most suitable measure for M&A performance because they are less affected by other factors on firm performance (Haleblian et al., 2009). The use of CAR relies on an efficient market assumption. The efficient market assumption states that traders evaluate stock prices on all applicable information and that any new relevant information emerging in an event will be quickly reflected by stock prices (MacWilliams & Siegel, 1997; Bromiley et al., 1988). In this study, a standard event study methodology based on the market model is used. The market model is described as follows:

$$R_{it} = \alpha_i + \beta_i \cdot R_{m_t} + \varepsilon_{it} \quad (1)$$

$R_{it}$ and $R_{mt}$ represent the rate of returns on the share price of company i and the market portfolio on day t, α is the intercept term, β is systematic risk of stock i, and $\varepsilon_{it}$. is the error term, which is assumed to be 0 (Park, 2004). The abnormal return (AR) on day t of a company i is calculated based on the parameter estimates $a_i$ and $b_i$ from the OLS regression of the market model:

$$AR_{it} = R_{it} - \left(a_i + b_i \cdot R_{m_t}\right) \quad (2)$$

Finally, the sum of the AR within the event window (t1, t2) result in CAR:

$$CAR_i = \sum_{t=t_1}^{t_2} AR_{it} \quad (3)$$

The market model is calculated with an estimation period of 250 trading days, 20 days prior to the event (Strong, 1992). Consistent with other studies, the cumulative abnormal return (CAR) is estimated for a short event window of 3 days (-1, +1), around the announcement date (day 0) (Seth et al., 2000; Fan & Goyal 2006). Additionally, the 3-day event window results are compared with two longer event windows of 11 days (-5, +5) and 21 days (-10, +10). The CAR is computed with stock price data and the S&P 500 index retrieved from the CRSP database.

### 4.3. Independent variables

To measure the independent variables for the hypotheses described in chapter 3, the sample acquisitions must be differentiated into vertical, product-extension, unrelated, and horizontal acquisitions. In to differentiate between these merger types, a stepwise approach is used. First, the sample is separated into vertical, horizontal, and unrelated acquisitions, following a similar approach to Fan & Goyal (2006), where industry commodity flows are utilized to identify vertical relatedness. Second, the horizontal- and unrelated acquisitions are divided into horizontal-, product-extension-, and unrelated acquisitions, using a text-based to assess differences in the firms' products and correct for insufficient classification by the NAICS code.

*Vertical acquisition.* Following Fan & Goyal (2006), the first step to measure vertical relatedness is to build an interindustry vertical relatedness coefficient matrix using Input-Output Use Tables (I.O. Tables) from the U.S. Bureau of Economic Analysis (BEA). These I.O. Use Tables contain commodity flows for each industry pair, as dollar value output from industry i consumed to produce industry j's output. Vertical relatedness $v_{ji}$ for each industry pair, i and j, is calculated as the output inflow of industry i, $a_{ji,}$ divided by the total output of industry j. The vertical relatedness coefficient is the maximum of the vertical relatedness factors $v_{ji}$ and $v_{ij}$. To connect these coefficients to each acquisition, the NAICS codes of the acquiring and target firms are matched with the I.O. Industries. These linkages of I.O. Industries and NAICS codes change over time and can introduce additional noise to this analysis (Ahern & Harford, 2014).

Thus, the BEA I.O. Use Table from 2002 is used to calculate the vertical relatedness coefficients (Table 2 in the Appendix). Mergers are identified as vertical when the vertical relatedness coefficient for the pair of industries is above 1%, which is consistent with Fan & Goyal (2006). Applying this method, 26 vertical acquisitions are identified from the M&A sample. In the first step, all other acquisitions are separated into horizontal acquisitions for matching acquirer and target NAICS codes and unrelated acquisitions for non-matching NAICS codes.

*Product-extension acquisition*. Since classification systems, such as the NAICS code and publicly available financial information, do not sufficiently differentiate between product categories among related firms, this study uses a text-based approach. For this purpose, the deal purpose description, acquiring company, and target company descriptions are retrieved from the Thomson Reuters SDC database. The deal purpose description contains specific keywords (e.g., extending product portfolio, improving operating margins, extending market reach with existing portfolio), which can differentiate between the merger types. These keywords are first used as an indicator for a purely horizontal or product-extension acquisition. In particular, a product-extension acquisition would contain keywords, such as "extending product offerings," "offering new products or services," and "extending the product portfolio." In a second step, the company descriptions of acquirer and target are compared for product offerings information. In cases of missing or insufficient product or company information, 10-k reports of the respective firm are retrieved from SEC EDGAR. Based on deal and product information, acquisitions are ultimately classified into three categories, horizontal and market-extension, product-extension, or unrelated acquisitions. Thus, product-extension acquisitions are computed as a binary variable.

*Market complementarity*. In order to assess the market complementarity between acquiring firms and target firms, the geographic sales data of each company in the sample is assigned according to the level-2 categorization of geographic sales distributions by FactSet: North

America, Latin America, America Unallocated, Africa, Middle East, Africa, and the Middle East Unallocated, Asia, Oceania, Asia and Oceania Unallocated, European Union, Non-European Union, Europe Unallocated and Other Regions. This study measures market complementarity by computing the Euclidean Distance (ED) of the geographic sales distribution as a percentage of total sales between acquiring and target firm. The ED is commonly used to assess the differences in multivariate data and especially cross-national studies (Berry et al., 2010). The market complementarity (MKT_ED) for the geographic sales distribution of the acquiring firm *q* and the target firm *p* for each acquisition *i* is calculated as follows:

$$MKT\_ED = \sqrt{\sum_{i=1}^{n}(ACQ\_SREG_i - TAR\_SREG_i)^2} \quad (4)$$

$ACQ\_SREG_i$ and $TAR\_SREG_i$ are the acquirers' and targets' sales data per region (Euclidean vectors), and n is the number of geographic sales regions.

*Acquisition experience*. Acquisition experience will be measured by the acquiring firm's number of past acquisitions until one year before the year of the acquisition event (Kaul & Wu, 2016; Chakrabarti & Mitchell, 2013).

### 4.4. Control variables

Several factors, which have been shown to influence M&A performance in previous research, are included as control variables in the regression models to separate their effects from the independent variables. In a study on acquisition performance prediction, King et al., 2020 identified acquiring firm size, acquiring firm debt, and payment type as necessary control variables for future M&A research on acquisition performance. Thus, *acquirer size* in total assets, *acquirer debt* in debt-to-equity, and *payment type* as two dummy variables for stock and cash payments are included as control variables. Additionally, the following control variables, which are commonly used by similar studies on M&A performance, are added: *Relative firm size* as the ratio of the acquirer's and target's number of employees, *acquirer stock exchange*

using dummy variables for different stock exchanges, *target firm size* in total assets, *acquisition experience* in the number of prior acquisitions, *acquirer and target firm prior performance* in return on assets (Cuypers et al., 2017; Kim & Finkelstein, 2001; King et al., 2008; King et al., 2020). Other frequently used control variables, such as *deal size* and *number of bidders*, are considered but not included due to missing data access and availability.

### 4.5. Statistical method

To test the above-hypothesized relationships, this study applies an Ordinary-Least-Squares (OLS) regression. The variables are added in a stepwise approach. First, the control variables and the main effects of hypotheses 1-3 are added independently. Before adding the interaction terms to test the moderating effects of hypothesis 4, acquisition experience (hypothesis 4a-4c) and market complementarity (hypothesis 4c) are standardized in both their main effect and interaction terms to improve interpretation of their coefficients (Aiken and West, 1991).

## 5. Results

### 5.1. Descriptive statistics, multicollinearity, and assumptions

The descriptive statistics and pairwise correlations of employed explanatory variables, and independent variables, for both samples, are presented in Table 3 and Table 4 in the Appendix. For the dependent variable, acquirer's cumulative abnormal returns, the full samples shows a slightly negative mean of -0.15%, indicating that on average, acquirer's stock returns in the pharmaceutical and biotechnological industry are negative for this study's sample.

Multicollinearity describes the presence of correlations between the predictor variables, which induces inflated standard errors and confidence intervals of coefficient estimates (Williams et al., 2013). Therefore, pairwise correlation tables for both the full and the sub-sample (Table 3 & 4) are computed. These tables show a low to moderate correlation for the majority of the predictor variables, with the highest correlation of 68,8% for the payment type dummy variables (cash and stock). To ensure that the results are not affected by multicollinearity issues, variance

inflation factors (VIF) are computed for every model (Cohen et al., 2013). The highest mean VIF value of 1.61 in Model 2 (Table 5 in the Appendix) is well below the conventional critical VIF value of 10, and thus it is determined that multicollinearity is not inflating the regression results (Chatterjee & Hadi, 2006).

In addition, several commonly used assumptions are tested since the violation of the underlying assumptions of regression analysis can cause biased estimates of relationships and untrustworthy significance tests (Chatterjee & Hadi, 2012; Williams et al., 2013). Thus, the following assumptions are tested: (1) normally distributed variables, (2) linear relationship between the independent and dependent variables, (3) homoscedasticity of errors (Osborne & Waters, 2002). For this purpose, normal probability-, and standardized residual plots are conducted. These scatter plots show no meaningful violation of the evaluated assumptions for any model, and thus it is inferred that the conducted analysis creates reliable results.

### 5.2. Test of hypotheses

The results of the statistical analysis are presented in Table 1 for the two different samples used in this study. The effect of vertical acquisitions (Hypothesis 1) and product-extension acquisitions (Hypothesis 2) on acquisition performance as well as their interaction with acquisition experience (Hypothesis 4a & 4b) are tested on the full sample in Model 1, 2, and 3, including all acquisition types (Table 1). The effect of market complementarity on acquisition performance (Hypothesis 3) and its interaction with acquisition experience (Hypothesis 4c) are tested on a sub-sample in Model 4, 5, and 6, excluding unrelated and vertical acquisitions.

Hypothesis 1 anticipated that vertical acquisitions perform better than other acquisition types of firms in the pharmaceutical and biotechnological industry. This association was tested independently in Model 2 ($B_2$ = -0.0122; p = 0.3822) and in Model 3 ($B_3$ = -0.0097; p = 0.5317), after adding the interaction terms with acquisition experience to the main effects. Since the

effect of vertical acquisitions is not significant in both models, and the parameter estimates are lower than all other acquisition types, Hypothesis 1 is not supported.

In Hypothesis 2, this study expected that product-extension acquisitions perform better than other acquisition types. The results for Model 2 ($B_2 = 0.0345$; $p = 0.0101$) exhibit that product-extension acquisitions exert significant ($p < 0.05$) and positive effect on acquisition performance, supporting Hypothesis 2. After adding the interaction terms with acquisition experience in Model 3 ($B_3 = 0.0352$; $p = 0.0095$), the independent positive effect of product-extension acquisitions on acquisition performance is slightly increased, and the results are strongly significant at the $p < 0.01$ level. Since the results of product-extension acquisitions are significant in both models and the parameter estimates are higher than all other acquisition types, vertical, unrelated, as well as horizontal and market-extension acquisitions (reference category), Hypothesis 2 is supported.

Among acquisitions between firms on similar levels of the value chain, namely horizontal, product-extension, and market-extension acquisitions, this study forecasted in Hypothesis 3 that market complementarity between target and acquirer, measured by the ED of geographic sales distributions, exerts a positive effect on acquisition performance. In Model 5 ($B_5 = 0.0437$; $p = 0.0880$) the analysis provides weakly significant results ($p < 0.1$) for a positive effect of market complementarity on acquisition performance. However, after adding the interaction term with acquisition experience in Model 6, the association between market complementarity and acquisition performance is no longer significant ($B_6 = 0.0104$; $p = 0.2311$). Thus, this analysis partially supports Hypothesis 3.

In Hypothesis 4, it was expected that there is a positive interaction effect between acquirer's acquisition experience and vertical acquisitions (Hypothesis 4a), product-extension acquisitions (Hypothesis 4b), and market complementarity (Hypothesis 4c) on acquisition performance. First, the results in Model 3 for the interaction term between vertical acquisition and acquisition

experience did not show a significant effect, not supporting Hypothesis 4a ($B_3$ = 0.0029; p = 0.8815). Similarly, Model 3 did not reveal any significant association between acquisition performance and the interaction of product-extension acquisitions and acquisition experience ($B_3$ = -0.0082; p = 0.4947). For the subsample consisting of product-extension, market-extension, and horizontal acquisitions, the interaction term in Model 6 between market complementarity and acquisition experience did not reveal a significant effect on acquisition performance ($B_6$ = -0.0042; p = 0.6689). Therefore, Hypothesis 4 was not supported.

In conclusion, this analysis provides strong support for the anticipated positive effect of product-extension acquisitions, confirming Hypothesis 2. However, the analysis found no evidence for the expected beneficial effect of firm complementarities in vertical acquisitions in Hypothesis 1 and the positive moderating effect of acquirer's acquisition experience in Hypothesis 4.

The above findings of this event study are based on a short 3-day event window (-1, 1) for the calculation of the dependent variable, the acquirer's cumulative abnormal returns around the acquisition announcement. Prior studies usually chose a longer event window of 11 or 21 days around the acquisition announcement to capture the full market reaction, from possible early insider reactions and deferred investor reactions. To assess the correctness of the event-window used, prior studies commonly ran robustness checks with different time-windows. Similarly, this study tested the robustness of the event study measure of the dependent variable, repeating the analysis with an 11-day (-5, +5) and a 21-day (-10, 10) event window (Table 6 & 7 in the Appendix). For Hypothesis 1, 2, 4a, and 4b, the 11-day event window produces similar results, supporting Hypothesis 2 in Model 2 ($B_2$ = 0.0420; p = 0.0464) and Model 3 ($B_3$ = 0.0423; p = 0.0464). However, Hypothesis 3 is not supported by the analysis with the 11-day window ($B_5$ = 0.0327; p = 0.3921). Interestingly, the results for the analysis based on the 21-day event window show no significant effect for any independent variable.

**Table 1.** OLS Regression: CAR (-1, +1) of M&A transactions in the Pharmaceutical and Biotechnology Industry

| | Model 1 | | Model 2 | | Model 3 | | Model 4 | | Model 5 | | Model 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | b, (se) | p | b, (se) | p | b, (se) | p | b, (se) | p | b, (se) | p | b, (se) | p |
| Intercept | 0.0321 | | 0.0353 | | 0.0366* | | 0.0469* | | 0.0132 | | 0.0377 | |
| | (0.0203) | 0.1167 | (0.0217) | 0.1069 | (0.0213) | 0.0899 | (0.0272) | 0.0893 | (0.0290) | 0.6510 | (0.0265) | 0.1597 |
| Acquirer performance | -0.0259 | | -0.0452 | | -0.0466 | | -0.0566 | | -0.0721* | | -0.0754* | |
| | (0.0325) | 0.4270 | (0.0320) | 0.1618 | (0.0326) | 0.1560 | (0.0433) | 0.1955 | (0.0417) | 0.0886 | (0.0426) | 0.0821 |
| Target performance | 0.0424* | | 0.0511** | | 0.0510** | | 0.0448* | | 0.0360 | | 0.0356 | |
| | (0.0218) | 0.0554 | (0.0216) | 0.0203 | (0.0218) | 0.0217 | (0.0267) | 0.0979 | (0.0254) | 0.1615 | (0.0256) | 0.1697 |
| Acquirer size | -0.0905 | | -0.1844 | | -0.1740 | | -0.1028 | | -0.1984 | | -0.1556 | |
| | (0.1554) | 0.5615 | (0.1516) | 0.2272 | (0.1537) | 0.2607 | (0.1720) | 0.5523 | (0.1660) | 0.2368 | (0.1946) | 0.4273 |
| Target size | 0.0175 | | 0.0024 | | -0.0004 | | 0.5002* | | 0.5175* | | 0.5339* | |
| | (0.0336) | 0.6029 | (0.0381) | 0.9507 | (0.0387) | 0.9921 | (0.2871) | 0.0864 | (0.2737) | 0.0634 | (0.2782) | 0.0597 |
| Relative firm size | 0.0026 | | 0.0037 | | 0.0036 | | 0.0036 | | 0.0038 | | 0.0039 | |
| | (0.0029) | 0.3648 | (0.0028) | 0.1818 | (0.0028) | 0.1969 | (0.0032) | 0.2623 | (0.0030) | 0.2117 | (0.0031) | 0.2114 |
| Acquirer debt | 0.0004 | | -0.0016 | | -0.0015 | | 0.0074 | | 0.0171 | | 0.0185 | |
| | (0.0169) | 0.9799 | (0.0162) | 0.9214 | (0.0163) | 0.9258 | (0.0495) | 0.8812 | (0.0469) | 0.7170 | (0.0473) | 0.6971 |
| Acquiror acquisition experience | -0.0111 | | 0.0027 | | 0.0030 | | 0.0049 | | 0.0355 | | 0.0067 | |
| | (0.0399) | 0.7809 | (0.0397) | 0.9459 | (0.0079) | 0.7055 | (0.0472) | 0.9177 | (0.0463) | 0.4460 | (0.0083) | 0.4229 |
| Payment type (Cash) | -0.0094 | | -0.0128 | | -0.0145 | | -0.0224 | | -0.0173 | | -0.0196 | |
| | (0.0174) | 0.5913 | (0.0172) | 0.4578 | (0.0175) | 0.4100 | (0.0222) | 0.3158 | (0.0211) | 0.4156 | (0.0219) | 0.3748 |
| Payment type (Stock) | -0.0536`*** | | -0.0579*** | | -0.0573*** | | -0.0590*** | | -0.0563*** | | -0.0578*** | |
| | (0.0158) | 0.0010 | (0.0152) | 0.0002 | (0.0153) | 0.0003 | (0.0191) | 0.0030 | (0.0185) | 0.0035 | (0.0190) | 0.0034 |
| Stock exchange (NYSE) | 0.0035 | | -0.0040 | | -0.0049 | | -0.0070 | | -0.0172 | | -0.0196 | |
| | (0.0132) | 0.7925 | (0.0131) | 0.7606 | (0.0133) | 0.7151 | (0.0180) | 0.7009 | (0.0181) | 0.3453 | (0.0191) | 0.3074 |
| Stock exchange (OTC) | 0.0402 | | 0.0291 | | 0.0278 | | 0.0784* | | 0.0632 | | 0.0644 | |
| | (0.0280) | 0.1544 | (0.0275) | 0.2918 | (0.0279) | 0.3216 | (0.0414) | 0.0627 | (0.0413) | 0.1312 | (0.0417) | 0.1278 |
| *Acquisition types:* Unrelated acquisition | | | 0.0256 | | 0.0268 | | | | | | | |
| | | | (0.038) | 0.4998 | (0.038) | 0.4852 | | | | | | |
| **H1.** Vertical acquisition | | | -0.0122 | | -0.0097 | | | | | | | |
| | | | (0.014) | 0.3822 | (0.015) | 0.5317 | | | | | | |
| **H2.** Product-extension acquisition | | | 0.0345** | | 0.0352*** | | | | 0.0392*** | | 0.0396*** | |
| | | | (0.013) | 0.0101 | (0.013) | 0.0095 | | | (0.014) | 0.0081 | (0.014) | 0.0080 |
| **H3.** Market complementarity | | | | | | | | | 0.0437* | | 0.0104 | |
| | | | | | | | | | (0.025) | 0.0880 | (0.009) | 0.2311 |
| *Interaction effects:* **H4a.** Vertical acquisition x acq. exp. | | | | | 0.0029 | | | | | | | |
| | | | | | (0.019) | 0.8815 | | | | | | |
| **H4b.** Product extension x acq. exp. | | | | | -0.0082 | | | | | | | |
| | | | | | (0.012) | 0.4947 | | | | | | |
| **H4c.** Market compl. x acquisition exp. | | | | | | | | | | | -0.0042 | |
| | | | | | | | | | | | (0.010) | 0.6689 |
| df | 11 | | 14 | | 16 | | 11 | | 13 | | 14 | |
| Observations | 104 | | 104 | | 104 | | 75 | | 75 | | 75 | |
| R-squared | 0.2364 | | 0.3226 | | 0.3269 | | 0.2802 | | 0.3015 | | 0.3794 | |
| Adj. R-squared | 0.1451 | | 0.2161 | | 0.2031 | | 0.1545 | | 0.1527 | | 0.2346 | |

Note: *** p < 0.01; ** p < 0.05; * p < 0.1; Standard errors are presented in parenthesis

## 6. Discussion

### 6.1. Interpretation of findings

It was argued that vertical acquisitions might offer greater potential for resource complementarities than other acquisition types since companies in vertical supplier-buyer relationships may have very different competencies and resource allocations (Harrison et al., 1991). However, the results did not reveal a significant association, indicating that vertical acquisitions are not more beneficial to acquiring firms than other acquisition types in the pharmaceutical and biotechnological industry. Moreover, the negative coefficients for the vertical acquisition variable suggest that vertical acquisitions may even destroy value for the acquiring company. One plausible explanation for this result may be that only some types of vertical acquisitions facilitate additional value creation opportunities through the redeployment of complementary resources and capabilities. As prior studies on complementarities emphasize, similarities or differences between two firms do not imply strategic fit (Bauer & Matzler, 2014). Although the findings of King et al. (2008) suggest that firms benefit from complementary resource allocations, different resource allocations of firms in vertical relationships may not necessarily imply resource complementarity. Another explanation for this result may be that vertical acquisitions may be pursued for other reasons than resource redeployment. For example, if a company acquires a supplier to reduce price fluctuation or to inhibit competitors from access to supplies, the acquisition may not necessarily involve resource sharing between target and acquirer and thus not benefit from resource complementarities.

Second, the results suggest that pharmaceutical and biotechnological firms benefit most from product-extension acquisitions, among all the different acquisition types. The results confirm Kim and Finkelstein's (2009) findings of a positive effect of complementary product strategies on acquisition performance. Thus, not only in the banking industry, where products are rather

homogenous but also in the pharmaceutical and biotechnological industry, acquisitions of firms with complementary product strategies may lead to value creation.

Third, the results only partially support the notion that market complementarity between acquiring and target firm creates value for the acquirer. Surprisingly, this outcome does not fully confirm the findings of Kim and Finkelstein (2009), suggesting that acquirers in the U.S. banking industry benefitted from targeting firms with complementary national markets. This outcome could potentially be explained by differences between the U.S. banking industry and the pharmaceutical and biotechnological industry, as well as different measurements. Whereas Kim & Finkelstein (2008) analyzed the complementarity of national geographic product markets, this study focused on the global geographic sales distribution. However, since pharmaceutical and biotechnological products may be subject to varying regulations across different nations, market complementarity may not necessarily imply value creation opportunities for the acquiring firm.

Finally, the findings suggest that experienced acquirers do not necessarily benefit more from vertical and product-extension acquisitions or access to complementary markets than inexperienced acquirers. Even though prior studies provided inconsistent evidence on the effect of acquisition experience (King et al., 2004; Haleblian & Finkelstein, 1999), this finding is surprising. Since acquisitions of complementary targets may involve high degrees of resource redeployment in both target and acquiring firms, more capable acquirers could be expected to create more value through efficient resource redeployment than other acquirers. Nevertheless, following Zollo and Singh (2004), acquisition experience may not necessarily imply that acquirers learn from their experience. Since the acquiring firm's managers may be biased by prior experience, acquisition performance may even be inhibited for acquisition involving firms on different value chain levels or firms with different product categories or geographic markets.

### 6.2. Theoretical & managerial implications

This study contributes to existing M&A literature in three major ways. First, this study attempts to investigate existing arguments in the M&A literature, especially regarding the performance benefits of complementarity firm characteristics, and connect these arguments to the different acquisition strategies or types. Comparing different acquisition types, the results indicate that pharmaceutical and biotechnological firms benefit most from product-extension acquisitions. Second, the findings add to the generalizability of the strategic fit notion. In particular, the analysis confirms the findings of Kim and Finkelstein (2008), suggesting that acquisitions that involve firms with complementary product strategies not only create value in the U.S. banking industry but also in the pharmaceutical and biotechnological industry. Third, this study highlights the importance of considering the acquisition strategy. Depending on the industry context and potentially other firm-specific aspects, certain acquisition strategies may facilitate more value creation potential than other acquisition strategies.

Furthermore, the findings hold several managerial implications. First, since the findings indicate that product-extension acquisitions may be the most beneficial acquisition strategy, it could be important for managers to analyze a potential target firm's product complementarity in order to assess its value creation potential. Second, while it may be important to pursue complementarity with a target firm in some characteristics, such as product categories, complementarity in other characteristics, such as different resource allocations involved in vertical acquisitions, may be less beneficial. Finally, even though the results only partially support a positive effect of market complementarity on acquisition experience, a target firm's geographic market fit could be another important factor for managers to assess the firm's value.

### 6.3. Limitations and implications for future research

Several limitations of this study and directions for future research are highlighted in the following. First, measuring M&A performance with short-term abnormal returns around the

transaction's announcement date provides limitations to this study. Although this type of measurement represents the most frequently used performance measure, it maintains several shortcomings (Haleblian et al., 2009). Since short-term abnormal returns only reflect the potential value observed in the strategic decision, this measure fails to incorporate the integration phase's effects (Bauer & Matzler, 2014; Haleblian et al., 2009). Furthermore, investors may fail to assess the real value of an acquisition decision due to limited information, and thus market valuation can be falsely evaluated (Gubbi et al., 2010). Second, data availability represented a major limitation to this study. Like most studies on acquisitions, this study relies on publicly available information on M&A transactions and company financials (Haleblian et al., 2009). Due to the limited availability of data on the acquiring and target firm's sales distribution, a relatively large timeframe is chosen to create a sufficient sample size, which may introduce a variety of exogenous effects. (Matsusaka, 1993; Moeller et al., 2004). Additionally, limited sales distribution data affects the reliability of the applied market complementarity measure. Since sales data with a sufficient granularity is not available, market complementarity is measured on a continent-wide level, failing to capture heterogeneity on a national or even regional level. Third, due to the absence of a sufficient measure, identifying different acquisition types, namely vertical and product-extension acquisitions, by using a text-based approach may introduce considerable noise to this study (Fan & Goyal, 2006; Frésard et al.,2017).

Future research may build on this study's findings in four different ways. First, while vertical acquisitions may not generally create value for the acquiring firm, further investigation of the performance implications of different types of vertical acquisitions, such as upstream or downstream acquisition, may provide additional insights. Moreover, it would be interesting to investigate the comparison of different acquisition types in other industries. Potentially, these findings may be replicable or change in other industry contexts, depending on firm-specific and industry-specific factors. Additionally, increasing the sample size and scope to more global

acquisitions, further study on the value creation effects of market complementarity between targets and acquirers could confirm the expected positive association with acquisition performance. Lastly, while this study fails to provide evidence for a positive interaction effect on acquisition performance between different acquisition types or market complementarity and acquisition experience, analysis of other acquisition capabilities may provide valuable insights.

## 7. Conclusion

This study investigated the role of firm characteristics and merger types in determining the acquisition performance of acquiring firms in the pharmaceutical and biotechnological industry. Whereas many studies in the literature on success factors of M&A focus on certain acquisition strategies, such as technological acquisitions or horizontal acquisitions, this analysis compared different acquisition types to assess their different value creation potentials. Following the notion of previous studies on strategic fit, arguing that strategic fit is increased by the complementarity of certain firm characteristics, this study reasoned that complementarities arising from specific acquisition types are beneficial to the acquiring firm.

To test the hypothesized relationships, a sample of 104 acquisitions within the pharmaceutical and biotechnological is analyzed with a short-term event study methodology. The findings confirm that product-extension acquisitions are more beneficial to acquiring firms than other acquisition types in this industry context. Furthermore, the analysis partially confirms that market complementarity between target and acquiring firm may facilitate synergies for the acquiring firm. Additionally, several limitations, such as the shortcomings of the applied measure of M&A performance, insufficient data availability, and unreliability in the identifying method of merger types, are highlighted. Future research may investigate the performance implications of different acquisition types in other industry contexts to build on these findings. Finally, strategic fit literature could investigate different dimensions of firm complementarity to determine the relevant dimensions to examine an acquisition's value creation potential.

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## Appendixes

**Table 2.** Vertical relatedness coefficient matrix

| Industry code | | 1150 | 2213 | 2303 | 3130 | 3251 | 3252 | 3253 | 3254 | 3255 | 3256 | 3259 | 3260 | 332B | 3334 | 3341 | 334A | 3344 | 3345 | 3346 | 3352 | 3353 | 3359 | 3361 | 3364 | 3391 | 4200 | 4830 | 5112 | 52A0 | 5310 | 5330 | 5411 | 5413 | 5415 | 5417 | 5418 | 5419 | 5500 | 561A | 6100 | 6210 | 6220 | 6230 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1150 | Support activities for agriculture and for. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2213 | Water, sewage and other systems | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2303 | Maintenance and repair construction | 0.00 | 0.10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3130 | Yarn, fabrics, and other textile mill prdct | 0.00 | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3251 | Basic chemicals | 0.00 | 0.00 | 0.00 | 0.02 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3252 | Resins, rubber, and artificial fibers | 0.00 | 0.00 | 0.00 | 0.17 | 0.35 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3253 | Agricultural chemicals | 0.16 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3254 | Pharmaceuticals and medicines | 0.01 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3255 | Paints, coatings, and adhesives | 0.00 | 0.00 | 0.01 | 0.00 | 0.16 | 0.08 | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3256 | Soaps, cleaning compounds, and toiletries | 0.00 | 0.00 | 0.00 | 0.01 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3259 | Other chemical products | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 0.06 | 0.00 | 0.00 | 0.02 | 0.01 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3260 | Plastics and rubber products | 0.01 | 0.00 | 0.02 | 0.00 | 0.04 | 0.16 | 0.01 | 0.01 | 0.03 | 0.05 | 0.02 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 332B | Other fabricated metal products | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.02 | 0.01 | 0.01 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3334 | HVAC and commercial refrigeration equip. | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.04 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3341 | Computer and peripheral equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 334A | Audio, video, and communications equip. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3344 | Semiconductors and electronic comp. | 0.00 | 0.00 | 0.00 | 0.01 | 0.03 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.14 | 0.20 | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3345 | Electronic instruments | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.01 | 0.00 | 0.00 | 0.10 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3346 | Magnetic media products | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.09 | 0.02 | 0.00 | 0.01 | 0.00 | 0.03 | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3352 | Household appliances | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.10 | 0.02 | 0.02 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | | | | | | | | | | | | | | | | | | | | | | | | |
| 3353 | Electrical equipment | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.03 | 0.05 | 0.00 | 0.00 | 0.04 | 0.01 | 0.00 | 0.06 | | | | | | | | | | | | | | | | | | | | | | |
| 3359 | Other electrical equipment and comp. | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.01 | 0.00 | 0.01 | 0.03 | 0.01 | 0.00 | 0.01 | 0.01 | | | | | | | | | | | | | | | | | | | | | |
| 3361 | Motor vehicles | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.02 | 0.00 | 0.00 | 0.01 | 0.02 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | | |
| 3364 | Aerospace products and parts | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.03 | 0.00 | 0.00 | 0.01 | 0.02 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | | |
| 3391 | Medical equipment and supplies | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.02 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | | | | | | | | | | | | | | |
| 4200 | Wholesale trade | 0.05 | 0.00 | 0.02 | 0.05 | 0.05 | 0.04 | 0.04 | 0.05 | 0.03 | 0.05 | 0.04 | 0.04 | 0.03 | 0.06 | 0.10 | 0.07 | 0.07 | 0.04 | 0.04 | 0.07 | 0.07 | 0.05 | 0.06 | 0.02 | 0.04 | | | | | | | | | | | | | | | | | |
| 4830 | Water transportation | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | | | | | | | | | | | | |
| 5112 | Software publishers | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.04 | 0.01 | 0.05 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | | | | | | | | | | | | | | | |
| 52A0 | Monetary authorities, credit intermed. | 0.01 | 0.03 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.02 | | | | | | | | | | | | | |
| 5310 | Real estate | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.02 | 0.06 | 0.03 | 0.03 | | | | | | | | | | | | | |
| 5330 | Rights to nonfinancial intangible assets | 0.00 | 0.01 | 0.00 | 0.00 | 0.02 | 0.01 | 0.01 | 0.00 | 0.02 | 0.00 | 0.02 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 0.02 | 0.03 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 0.02 | 0.03 | | | | | | | | | | | | |
| 5411 | Legal services | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01 | 0.05 | 0.01 | | | | | | | | | | |
| 5413 | Architectural, engineering, and related serv. | 0.03 | 0.04 | 0.05 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.00 | | | | | | | |
| 5415 | Computer systems design and related serv. | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.03 | 0.00 | 0.01 | 0.02 | | | | | | | | | |
| 5417 | Scientific research and development serv. | 0.00 | 0.01 | 0.02 | 0.00 | 0.03 | 0.03 | 0.03 | 0.04 | 0.04 | 0.03 | 0.05 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.02 | 0.03 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.02 | 0.03 | 0.00 | 0.01 | 0.02 | 0.01 | | | | | | | |
| 5418 | Advertising and related services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.02 | 0.02 | 0.01 | 0.03 | 0.02 | 0.03 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | | | | | | | |
| 5419 | Other professional and technical services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.03 | 0.00 | 0.00 | 0.02 | 0.00 | 0.02 | 0.02 | | | | | |
| 5500 | Management of companies and enterprises | 0.00 | 0.00 | 0.00 | 0.05 | 0.06 | 0.09 | 0.09 | 0.12 | 0.11 | 0.10 | 0.14 | 0.04 | 0.03 | 0.04 | 0.08 | 0.08 | 0.09 | 0.10 | 0.09 | 0.04 | 0.06 | 0.05 | 0.03 | 0.08 | 0.03 | 0.04 | 0.02 | 0.03 | 0.02 | 0.02 | 0.02 | 0.02 | 0.01 | 0.02 | 0.01 | 0.07 | 0.01 | | | | | |
| 561A | All other administrative and support serv. | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.01 | 0.01 | 0.02 | 0.01 | 0.04 | 0.01 | 0.03 | 0.01 | 0.03 | 0.03 | 0.02 | 0.04 | 0.01 | 0.01 | 0.01 | | | |
| 6100 | Educational services | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.11 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.02 | 0.00 | 0.02 | | | |
| 6210 | Ambulatory health care services | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.00 | 0.01 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.02 | 0.00 | | |
| 6220 | Hospital care | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.01 | 0.00 | 0.02 | |
| 6230 | Nursing and residential care | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 |
| 6240 | Social assistance | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 |

**Table 3.** Descriptive statistics and correlations of key variables (full sample, N = 104)

| Variables | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 CAR | -0.0015 | 0.0570 | | | | | | | | | | | | | | |
| 2 Vertical acquisition | 0.2500 | 0.4351 | -0.1249 | | | | | | | | | | | | | |
| 3 Product-extension acq. | 0.2596 | 0.4406 | 0.2583*** | -0.3419*** | | | | | | | | | | | | |
| 4 Unrelated acquisition | 0.0289 | 0.1682 | -0.0197 | -0.0995 | -0.1021 | | | | | | | | | | | |
| 5 Acquirer performance | 0.0068 | 0.2196 | 0.0506 | -0.2446** | 0.1089 | 0.0455 | | | | | | | | | | |
| 6 Target performance | -0.1616 | 0.2803 | 0.2189** | 0.1712* | 0.0115 | 0.0009 | 0.1968** | | | | | | | | | |
| 7 Acquirer size | 0.0267 | 0.0466 | 0.0154 | -0.2382** | 0.1771* | -0.0970 | 0.1581 | -0.0654 | | | | | | | | |
| 8 Target size | 0.0264 | 0.1604 | 0.0071 | -0.0385 | -0.0546 | 0.5562*** | 0.0363 | 0.1083 | -0.0765 | | | | | | | |
| 9 Relative firm size | 1.1370 | 2.4984 | 0.0555 | -0.1722* | 0.0431 | -0.0769 | 0.1494 | -0.2786*** | 0.5983*** | -0.0748 | | | | | | |
| 10 Acquirer debt | 0.1144 | 0.3894 | 0.0151 | 0.1471 | -0.0434 | -0.0405 | -0.54193*** | 0.1168 | -0.0723 | -0.0170 | -0.0649 | | | | | |
| 11 Acquiror acquisition exp. | 0.1493 | 0.1639 | 0.0468 | -0.2427** | 0.0038 | -0.0521 | 0.2580*** | 0.0971 | 0.5064*** | 0.0332 | 0.3437*** | -0.1356 | | | | |
| 12 Payment type (Cash) | 0.7500 | 0.4351 | 0.2643*** | -0.1282 | 0.0380 | -0.2985*** | 0.0044 | 0.1153 | 0.1206 | -0.1878* | 0.0854 | 0.0695 | 0.1419 | | | |
| 13 Payment type (Stock) | 0.4135 | 0.4948 | -0.4129*** | 0.1015 | -0.0073 | 0.2053** | -0.2732*** | -0.1438 | -0.1726* | 0.1372 | -0.1713* | 0.1184 | -0.2084** | -0.6877*** | | |
| 14 Stock Exchange (NYSE) | 0.4904 | 0.5023 | 0.0781 | -0.1222 | 0.2088** | -0.0541 | 0.2588*** | 0.1400 | 0.4815*** | -0.0728 | 0.3996*** | -0.0584 | 0.4911*** | 0.1666* | -0.1987** | |
| 15 Stock Exchange (OTC) | 0.0385 | 0.1932 | 0.1191 | 0.1155 | 0.1097 | -0.0345 | -0.1651* | -0.0616 | -0.1138 | -0.0330 | -0.0873 | -0.0427 | -0.1494 | 0.0000 | 0.0352 | -0.1962** |

Note: *** p < 0.01; ** p < 0.05; * p < 0.1

**Table 4.** Descriptive statistics and correlations of key variables (sub-sample, N = 75)

| Variables | Mean | SD | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 CAR | 0.0031 | 0.0608 | | | | | | | | | | | | | |
| 2 Market complementarity | 0.3611 | 0.2829 | 0.2029* | | | | | | | | | | | | |
| 3 Product-extension acq. | 0.3600 | 0.4832 | 0.2513** | -0.1583 | | | | | | | | | | | |
| 4 Acquirer performance | 0.0366 | 0.1748 | 0.0672 | 0.2988*** | 0.0450 | | | | | | | | | | |
| 5 Target performance | -0.1903 | 0.3020 | 0.2435** | 0.1474 | 0.0853 | 0.3619*** | | | | | | | | | |
| 6 Acquirer size | 0.0344 | 0.0522 | -0.0344 | 0.2615** | 0.0895 | 0.1113 | -0.0235 | | | | | | | | |
| 7 Target size | 0.0095 | 0.0262 | 0.1437 | 0.0244 | 0.0635 | 0.0804 | 0.2679** | -0.1069 | | | | | | | |
| 8 Relative firm size | 1.4386 | 2.8315 | 0.0254 | 0.2423** | -0.0322 | 0.1199 | -0.2797** | 0.5752*** | -0.1805 | | | | | | |
| 9 Acquirer debt | 0.0838 | 0.1388 | 0.0003 | -0.0334 | 0.0117 | 0.0202 | 0.1166 | -0.0931 | 0.0454 | -0.1012 | | | | | |
| 10 Acquiror acquisition exp. | 0.1751 | 0.1772 | -0.0038 | 0.1730 | -0.1052 | 0.1929* | 0.1265 | 0.4675*** | -0.1055 | 0.2947** | -0.2165* | | | | |
| 11 Payment type (Cash) | 0.8133 | 0.3923 | 0.1639 | 0.0514 | -0.0684 | 0.0040 | 0.1142 | 0.0571 | -0.1654 | 0.0598 | -0.0412 | 0.0954 | | | |
| 12 Payment type (Stock) | 0.3600 | 0.4832 | -0.3645*** | -0.2538** | 0.0741 | -0.2558** | -0.1639 | -0.1284 | 0.2077* | -0.1647 | 0.0777 | -0.1526 | -0.6388*** | | |
| 13 Stock Exchange (NYSE) | 0.5333 | 0.5023 | 0.0016 | 0.1075 | 0.2005* | 0.2071* | 0.1134 | 0.5238*** | 0.1933* | 0.4189*** | 0.0206 | 0.4945*** | 0.0320 | -0.0780 | |
| 14 Stock Exchange (OTC) | 0.0267 | 0.1622 | 0.2480** | -0.1715 | 0.2207* | 0.0550 | 0.0441 | -0.1079 | -0.0592 | -0.0804 | -0.0275 | -0.1223 | 0.0793 | -0.1241 | -0.1770 |

Note: *** p < 0.01; ** p < 0.05; * p < 0.1

**Table 5.**Variance Inflation factors: CAR (-1, 1) of M&A transactions in the Biotechnology Industry Cluster

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|---|---|---|---|---|---|---|
| Intercept | 0.0000 | 0.0000 | - | 0.0000 | 0.0000 | - |
| Acquirer performance | 1.8832 | 1.9988 | - | 1.3544 | 1.4023 | - |
| Target performance | 1.3870 | 1.4826 | - | 1.5346 | 1.5485 | - |
| Acquirer size | 1.9396 | 2.0146 | - | 1.9095 | 1.9594 | - |
| Target size | 1.0738 | 1.5082 | - | 1.3383 | 1.3531 | - |
| Relative firm size | 1.8734 | 1.9020 | - | 1.8984 | 1.9419 | - |
| Acquirer debt | 1.6025 | 1.6051 | - | 1.1142 | 1.1143 | - |
| Acquiror acquisition experience | 1.5825 | 1.7058 | - | 1.6562 | 1.6589 | - |
| Payment type (Cash) | 2.1117 | 2.2587 | - | 1.7928 | 1.8108 | - |
| Payment type (Stock) | 2.2501 | 2.2724 | - | 2.0152 | 2.1089 | - |
| Stock exchange (NYSE) | 1.6287 | 1.7510 | - | 1.9367 | 1.9987 | - |
| Stock exchange (OTC) | 1.0854 | 1.1372 | - | 1.0656 | 1.1194 | - |
| *Acquisition types:* | | | - | | | - |
| Unrelated acquisition | - | 1.6283 | - | - | - | - |
| Vertical acquisition | - | 1.4842 | - | - | - | - |
| Product-extension acquisition | - | 1.3486 | - | - | - | - |
| Market complementarity | - | - | | - | 1.3315 | - |
| **Mean VIF** | 1.5348 | 1.6065 | - | 1.4680 | 1.4883 | - |

**Table 6.** OLS Regression: CAR (-5, +5) of M&A transactions in the Pharmaceutical and Biotechnology Industry

| | Model 1 | | Model 2 | | Model 3 | | Model 4 | | Model 5 | | Model 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | b, (se) | p | b, (se) | p | b, (se) | p | b, (se) | p | b, (se) | p | b, (se) | p |
| Intercept | 0.0132 | | 0.0150 | | 0.0120 | | 0.0298 | | -0.0014 | | 0.0234 | |
| | (0.0314) | 0.6751 | (0.0344) | 0.6643 | (0.0336) | 0.7230 | (0.0396) | 0.4552 | (0.0436) | 0.9752 | (0.0396) | 0.5562 |
| Acquirer performance | -0.0451 | | -0.0677 | | -0.0757 | | -0.1373** | | -0.1498** | | -0.1610** | |
| | (0.0503) | 0.3722 | (0.0509) | 0.1863 | (0.0514) | 0.1445 | (0.0631) | 0.0333 | (0.0627) | 0.0199 | (0.0637) | 0.0142 |
| Target performance | 0.0416 | | 0.0518 | | 0.0522 | | 0.0515 | | 0.0428 | | 0.0413 | |
| | (0.0338) | 0.2214 | (0.0343) | 0.1348 | (0.0344) | 0.1328 | (0.0389) | 0.1900 | (0.0382) | 0.2673 | (0.0382) | 0.2843 |
| Acquirer size | 0.2096 | | 0.0997 | | 0.1315 | | 0.1296 | | 0.0350 | | 0.1798 | |
| | (0.2406) | 0.3859 | (0.2406) | 0.6796 | (0.2426) | 0.5891 | (0.2508) | 0.6072 | (0.2498) | 0.8892 | (0.2909) | 0.5389 |
| Target size | 0.0762 | | 0.0517 | | 0.0509 | | 0.8410** | | 0.8850** | | 0.9405** | |
| | (0.0520) | 0.1463 | (0.0605) | 0.3944 | (0.0611) | 0.4069 | (0.4186) | 0.0488 | (0.4117) | 0.0356 | (0.4158) | 0.0273 |
| Relative firm size | 0.0020 | | 0.0033 | | 0.0032 | | 0.0041 | | 0.0048 | | 0.0049 | |
| | (0.0044) | 0.6541 | (0.0044) | 0.4469 | (0.0044) | 0.4705 | (0.0046) | 0.3804 | (0.0046) | 0.3026 | (0.0046) | 0.2928 |
| Acquirer debt | -0.0412 | | -0.0436* | | -0.0430* | | 0.0389 | | 0.0509 | | 0.0558 | |
| | (0.0262) | 0.1186 | (0.0257) | 0.0930 | (0.0258) | 0.0985 | (0.0721) | 0.5913 | (0.0705) | 0.4733 | (0.0707) | 0.4338 |
| Acquiror acquisition experience | -0.0479 | | -0.0295 | | -0.0042 | | -0.0127 | | 0.0258 | | 0.0060 | |
| | (0.0618) | 0.4403 | (0.0629) | 0.6405 | (0.0125) | 0.7393 | (0.0688) | 0.8541 | (0.0696) | 0.7118 | (0.0124) | 0.6315 |
| Payment type (Cash) | 0.0169 | | 0.0141 | | 0.0127 | | -0.0034 | | 0.0011 | | -0.0066 | |
| | (0.0269) | 0.5309 | (0.0273) | 0.6077 | (0.0276) | 0.6475 | (0.0324) | 0.9165 | (0.0317) | 0.9714 | (0.0327) | 0.8410 |
| Payment type (Stock) | -0.0545** | | -0.0594** | | -0.0571** | | -0.0658** | | -0.0657** | | -0.0710** | |
| | (0.0244) | 0.0281 | (0.0241) | 0.0154 | (0.0242) | 0.0204 | (0.0278) | 0.0212 | (0.0278) | 0.0214 | (0.0284) | 0.0151 |
| Stock exchange (NYSE) | -0.0012 | | -0.0107 | | -0.0143 | | -0.0141 | | -0.0290 | | -0.0372 | |
| | (0.0205) | 0.9518 | (0.0208) | 0.6072 | (0.0210) | 0.4998 | (0.0263) | 0.5945 | (0.0272) | 0.2916 | (0.0285) | 0.1976 |
| Stock exchange (OTC) | 0.0317 | | 0.0180 | | 0.0204 | | 0.0803 | | 0.0548 | | 0.0587 | |
| | (0.0434) | 0.4676 | (0.0436) | 0.6812 | (0.0441) | 0.6439 | (0.0603) | 0.1882 | (0.0622) | 0.3820 | (0.0623) | 0.3504 |
| *Acquisition types:* Unrelated acquisition | | | 0.0428 | | 0.0415 | | | | | | | |
| | | | (0.0599) | 0.4770 | (0.0602) | 0.4926 | | | | | | |
| **H1.** Vertical acquisition | | | -0.0127 | | 0.0423 | | | | | | | |
| | | | (0.0221) | 0.5665 | (0.0210) | 0.9934 | | | | | | |
| **H2.** Product-extension acquisition | | | 0.0420** | | 0.0415** | | | | 0.0476** | | 0.0490** | |
| | | | (0.0208) | 0.0464 | (0.0602) | 0.0464 | | | (0.0216) | 0.0311 | (0.0216) | 0.0270 |
| **H3.** Market complementarity | | | | | | | | | 0.0327 | | 0.0025 | |
| | | | | | | | | | (0.0380) | 0.3921 | (0.0128) | 0.8478 |
| *Interaction effects:* **H4a.** Vertical acquisition x acq. exp. | | | | | 0.0326 | | | | | | | |
| | | | | | (0.0306) | 0.2889 | | | | | | |
| **H4b.** Product extension x acq. exp. | | | | | -0.0084 | | | | | | | |
| | | | | | (0.0190) | 0.6582 | | | | | | |
| **H4c.** Market compl. x acquisition exp. | | | | | | | | | | | -0.0143 | |
| | | | | | | | | | | | (0.0147) | 0.3349 |
| df | 11 | | 14 | | 16 | | 11 | | 13 | | 14 | |
| Observations | 104 | | 104 | | 104 | | 75 | | 75 | | 75 | |
| R-squared | 0.2011 | | 0.2558 | | 0.2692 | | 0.2398 | | 0.3000 | | 0.3109 | |
| Adj. R-squared | 0.1055 | | 0.1388 | | 0.1348 | | 0.1071 | | 0.1508 | | 0.1501 | |

Note: *** p < 0.01; ** p < 0.05; * p < 0.1; Standard errors are presented in parenthesis

**Table 7.** OLS Regression: CAR (-10, 10) of M&A transactions in the Biotechnology Industry Cluster

| | Model 1 | | Model 2 | | Model 3 | | Model 4 | | Model 5 | | Model 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | b, (se) | p | b, (se) | p | b, (se) | p | b, (se) | p | b, (se) | p | b, (se) | p |
| Intercept | 0.0078 | | 0.0242 | | 0.0152 | | 0.0377 | | 0.0349 | | 0.0299 | |
| | (0.0413) | 0.8503 | (0.0455) | 0.5958 | (0.0440) | 0.7296 | (0.0487) | 0.5452 | (0.0542) | 0.5222 | (0.0494) | 0.5471 |
| Acquirer performance | -0.0006 | | -0.0281 | | -0.0426 | | -0.1243 | | -0.1188 | | -0.1270 | |
| | (0.0661) | 0.9928 | (0.0673) | 0.6773 | (0.0672) | 0.5271 | (0.0775) | 0.3351 | (0.0779) | 0.1323 | (0.0796) | 0.1159 |
| Target performance | 0.0323 | | 0.0449 | | 0.0453 | | 0.0426 | | 0.0396 | | 0.0385 | |
| | (0.0444) | 0.4695 | (0.0454) | 0.3253 | (0.0450) | 0.3165 | (0.0477) | 0.4316 | (0.0475) | 0.4080 | (0.0478) | 0.4236 |
| Acquirer size | 0.3484 | | 0.2100 | | 0.2760 | | 0.2019 | | 0.1695 | | 0.2760 | |
| | (0.3161) | 0.2733 | (0.3184) | 0.5111 | (0.3170) | 0.3864 | (0.3078) | 0.4005 | (0.3103) | 0.5870 | (0.3633) | 0.4505 |
| Target size | 0.0982 | | 0.1204 | | 0.1145 | | 1.2023 | | 1.3118** | | 1.3526** | |
| | (0.0683) | 0.1541 | (0.0800) | 0.1359 | (0.0798) | 0.1549 | (0.5138) | 0.1342 | (0.5116) | 0.0128 | (0.5193) | 0.0116 |
| Relative firm size | 0.0004 | | 0.0017 | | 0.0013 | | 0.0037 | | 0.0054 | | 0.0055 | |
| | (0.0058) | 0.9387 | (0.0058) | 0.7667 | (0.0057) | 0.8181 | (0.0057) | 0.3541 | (0.0057) | 0.3475 | (0.0057) | 0.3437 |
| Acquirer debt | -0.0390 | | -0.0418 | | -0.0407 | | 0.0997 | | 0.1123 | | 0.1159 | |
| | (0.0344) | 0.2597 | (0.0340) | 0.2227 | (0.0337) | 0.2301 | (0.0885) | 0.4653 | (0.0877) | 0.2048 | (0.0884) | 0.1946 |
| Acquiror acquisition experience | -0.0911 | | -0.0837 | | -0.0085 | | -0.0528 | | -0.0105 | | -0.0008 | |
| | (0.0812) | 0.2647 | (0.0833) | 0.3175 | (0.0163) | 0.6061 | (0.0845) | 0.4716 | (0.0865) | 0.9034 | (0.0155) | 0.9576 |
| Payment type (Cash) | 0.0121 | | -0.0006 | | -0.0055 | | -0.0216 | | -0.0220 | | -0.0277 | |
| | (0.0353) | 0.7321 | (0.0361) | 0.9868 | (0.0361) | 0.8793 | (0.0397) | 0.6845 | (0.0394) | 0.5785 | (0.0409) | 0.5004 |
| Payment type (Stock) | -0.0462 | | -0.0528 | | -0.0483 | | -0.0642 | | -0.0731** | | -0.0770** | |
| | (0.0321) | 0.1525 | (0.0318) | 0.1004 | (0.0316) | 0.1299 | (0.0342) | 0.1533 | (0.0346) | 0.0386 | (0.0354) | 0.0337 |
| Stock exchange (NYSE) | 0.0080 | | 0.0014 | | -0.0055 | | -0.0092 | | -0.0310 | | -0.0370 | |
| | (0.0269) | 0.7657 | (0.0275) | 0.9603 | (0.0275) | 0.8422 | (0.0322) | 0.7689 | (0.0338) | 0.3629 | (0.0356) | 0.3025 |
| Stock exchange (OTC) | 0.0505 | | 0.0378 | | 0.0395 | | 0.0839 | | 0.0384 | | 0.0412 | |
| | (0.0570) | 0.3778 | (0.0577) | 0.5136 | (0.0576) | 0.4945 | (0.0741) | 0.4493 | (0.0773) | 0.6213 | (0.0779) | 0.5982 |
| *Acquisition types:* Unrelated acquisition | | | -0.0472 | | -0.0472 | 0.5503 | | | | | | |
| | | | (0.0793) | 0.5533 | (0.0787) | | | | | | | |
| **H1.** Vertical acquisition | | | -0.0266 | | -0.0032 | | | | | | | |
| | | | (0.0293) | 0.3655 | (0.0319) | 0.9206 | | | | | | |
| **H2.** Product-extension acquisition | | | 0.0413 | | 0.0429 | | | | 0.0469* | | 0.0480* | |
| | | | (0.0275) | 0.1376 | (0.0274) | 0.1209 | | | (0.0268) | 0.0846 | (0.0270) | 0.0804 |
| **H3.** Market complementarity | | | | | | | | | -0.0259 | | -0.0123 | |
| | | | | | | | | | (0.0472) | 0.5854 | (0.0160) | 0.4448 |
| *Interaction effects:* **H4a.** Vertical acquisition x acq. exp. | | | | | 0.0549 | | | | | | | |
| | | | | | (0.0400) | 0.1731 | | | | | | |
| **H4b.** Product extension x acq. exp. | | | | | -0.0266 | | | | | | | |
| | | | | | (0.0248) | 0.2860 | | | | | | |
| **H4c.** Market compl. x acquisition exp. | | | | | | | | | | | -0.0105 | |
| | | | | | | | | | | | (0.0184) | 0.5692 |
| df | 11 | | 14 | | 16 | | 11 | | 13 | | 14 | |
| Observations | 104 | | 104 | | 104 | | 75 | | 75 | | 75 | |
| R-squared | 0.1305 | | 0.1786 | | 0.2128 | | 0.1983 | | 0.2435 | | 0.2476 | |
| Adj. R-squared | 0.0265 | | 0.0493 | | 0.0680 | | 0.0583 | | 0.0823 | | 0.0720 | |

Note: *** p < 0.01; ** p < 0.05; * p < 0.1; Standard errors are presented in parenthesis