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Creating Value from the Outside - Announcement Effects of Corporate Venture Capital Investments in the Automotive Industry

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Abstract

The automotive industry is facing a major transformation where investments into new entrepreneurial ventures have dramatically increased. By conducting an event study, this research analyzes the short-term return effects of corporate venture capital investments to automotive manufacturers. Based on a sample of 192 investments in the automotive industry between 2008 and 2021, significant positive abnormal returns to investing firms were determined. This study further examines potential factors influencing the abnormal returns by performing a multivariate analysis. Results reveal that geographic distance and the current trends of the industry, namely autonomous driving, electrification, digitization and MaaS significantly influence abnormal returns.

Keywords: Corporate venture capital, announcement effects, event study, automotive industry

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1. **Introduction**

The future of the automotive industry has never been so uncertain. Nor so exciting. Will fully autonomous cars be rolling off the production line by 2030? Will electric vehicles gain a superior share of new car registrations? How will other alternative mobility solutions develop over time? How do "smart" cars not only mobilize people but accompany them in their everyday lives with helpful digital solutions? What will prevail – and, most importantly, when? And who will be the big players? The automotive industry is driven by climate change and the associated pressure for emission-free driving as well as digitization and connectivity which radically change the automotive product (PWC 2018). This transformation offers not only opportunities for new business models but also increases the number of firms entering the market. To protect against new players and a raising competition, automotive manufacturers need to adapt to new digital business models (McKinsey&Company 2016). One way to drive future growth and financial returns is to increase M&A activity, in particular increase venture capital investments and build strategic alliances with entrepreneurial ventures (Ernst&Young 2020). The amount of funding in entrepreneurial ventures in the automotive industry heavily increased in recent years, underlining the current transformation (Appendix 1). Due to this increasing trend, the academic community has paid increasing attention to corporate venture capital in recent years (Dushnitsky and Lenox 2006; Benson and Ziedonis 2005). Most of the studies examined whether corporate venture capital (CVC) investments create value for the shareholder of the investing company. Another field heavily researched is the effect of M&A announcements on shareholder returns (Fuller, Netter, and Stegemoller 2002). However little research attributes to whether CVC creates value for the shareholder in the automotive industry and if so, what are the determinants behind this value creation. Hence the research questions are formulated as follows:

1. *Do CVC announcements in the automotive industry influence the short-term abnormal returns of the investing company?*
2. *Which factors influence the short-term abnormal returns for investing companies in the automotive industry?*

To examine the research questions, the paper investigates several variables, while analyzing their effect on the short-term abnormal returns from CVC. Following this approach, the research aims to provide meaningful insights into the area of CVC investments in the automotive industry, a sector that has not become much attention in this part of the literature. The contribution of this study to the current literature is threefold. First, while previous research primarily focused on announcement effects of M&A acquisitions, studies on CVC announcement effects are limited. Second, this paper focuses on the automotive industry since corporate investors also aim for strategic objectives (Dushnitsky and Lenox 2005). Finally, this research analyzes whether certain geographic, industry and trend characteristics are related to the short-term performance of investing automotive companies.

To answer the above stated research questions this paper analyzes automotive corporate investor returns over the period from 2008 to 2021. The timeframe has been chosen since corporate venture capital activity has strongly increased in recent years (Graph 1). The data of the investments are obtained from Crunchbase, while stock prices have been collected from Yahoofinance.com (see further details in Chapter 3). Once the final sample has been composed, an event study and multiple OLS regressions have been applied.

This paper follows with an analysis of existing literature on CVC theory including the motivation of investing firms, the announcement effects of CVC investments and M&A acquisitions as well as investigating potential factors influencing these effects. This section further develops the hypotheses which are later tested in the OLS regression. Chapter 3 explains the dataset and applied

methodology. In Chapter 4, results and findings will be described. Chapter 5 discusses the results and relates them to the existing literature. In addition, the research questions will be answered. Lastly, findings will be concluded and limitations as wells as implications for future research are provided.

2. Literature Review

This section examines the research question by reviewing the current state of literature on the topic. The literature review first assesses the companies' motivations for corporate venture capital and then specifically highlights the motives for the automotive industry. Furthermore, an overview of present research addressing announcement effects of CVC investments and M&A acquisitions is presented. Finally, potential determinants that affect the short-term abnormal returns of investing companies are being discussed and hypotheses are developed.

2.1 Motivations for Corporate Venture Capital in the Automotive Industry

Several studies in the past have analyzed the motives of companies to engage in CVC investments (Basu, Phelps, and Kotha 2011; Mathews 2006; Hellmann 2002). First, this paper investigates the existing studies on the motivation for CVC in general. Additionally, the motives that are responsible for the growing number of CVC investments in the automotive industry will be analyzed.

Before reviewing the drivers and motives for CVC, the term itself is defined. (Gompers and Lerner 2000) define corporate venture capital as minority equity investments made by corporates in privately owned entrepreneurial startups. Although CVC and VC funds have the same objective, creating value for their shareholders/investors, corporate venture capital investments distinguish from the traditional VC fund that purely aims for financial returns. Besides financial returns, CVC may also add strategic value to the investing firm (Mathews 2006; Hellmann 2002). Basu, Phelps,

and Kotha (2011) report that especially in changing environments companies face the need for strategic adaptation. They further propose CVC investing as one possibility to pursue strategic adaptation besides strategic alliances, and acquisitions. Dushnitsky and Lenox (2005) support this hypothesis by arguing that strategic objectives generally dominate when pursuing CVC investments. Gompers and Lerner (2000) even further underline by stating that corporate venture capital investments tend to be even more successful when the strategic objectives between the corporate parent and the portfolio firm are similar. However, they further mentioned that a strong focus on strategy is critical. These findings from the literature on motives for CVC investments align with the current studies on the automotive industry from large consulting firms. McKinsey&Company (2016) and PWC (2018) describe the transformation of the automotive industry towards 2030 and the need for manufacturers to adapt to these new challenges which stem from a rapidly changing automotive environment. They propose the adjustment of traditional business models and the enhancement of new capabilities. They further promote to increase expenditures in R&D and increase investments in the electrical and digitized future.

To conclude, the literature states that while traditional VC funds explicitly seek for financial returns, the motives for CVC are twofold. Strategic objectives represent another important motive when pursuing CVC investments. Especially in the automotive industry, which is facing a large transformation, these financial and strategic motivations to transform the traditional business model hold true.

2.3 Announcement Effects of M&A acquisitions & CVC investments

Over the last decades, several studies investigated value creation through CVC investments (Wadhwa, Phelps, and Kotha 2016; Dushnitsky and Lenox 2006). Utilizing a mixture of approaches and methods, researchers were examining the creation of synergies between the

investing firm and the entrepreneurial venture. Another field that was extensively researched is mergers and acquisitions (M&A) announcement effects. However, this is vastly different from venture investment given the deal size, early stage, and innovation synergy potential. However, little to no research has been done on the short-term return effects of CVC announcements, especially in the automotive industry. This paper tries to bridge the gap between the success in corporate venturing and wealth creation in the stock market.

Fuller, Netter, and Stegemoller (2002) studied shareholder returns in public firms that acquired public, private or subsidiary targets. They state that, while target company shareholders gain significant returns, shareholders of the acquiring company only gain when buying a private firm or a public subsidiary. The return is zero or even negative when the acquirer buys a public firm. They discuss that this may be due to valuation errors of the assets, as the market for private targets is illiquid. Hence, the mistaken valuation leads to a liquidity discount and thus in a higher return for the acquirer.

These findings are supported by the research done from José Manuel Campa and Hernando (2004) who conducted an analysis of M&A transaction announcements in the European Union from 1998-2000. They found out that target firms receive a positive significant cumulative abnormal return from announcement effects. In contrast, returns for shareholders of the acquiring company were negative in over 50% of the analyzed transactions. Their findings are consistent with the results from (Fuller, Netter, and Stegemoller 2002). Laabs and Schiereck (2010) went even further into detail and analyzed a sample of 230 acquisition announcements between 1981 and 2007 to analyze the performance of acquirers in the automotive supply industry for a long time horizon. They found significant positive returns to acquiring companies for a short-term horizon. However, for a period of three years their results hold not true, and their model shows a value destruction of up to 20%. Mentz and Schiereck (2008) conducted another investigation about cross-border mergers and

acquisitions in the automotive industry. They analyzed a sample of over 100 takeovers and found a significant wealth creation for acquiring companies, thus underlining the above-mentioned findings. To summarize, while previous studies on M&A announcement effects in general have no or negative returns for the acquiring company, studies on M&A announcement effects in the automotive industry show different results. Hence, the first hypothesis of this paper analyzes if those results also hold for CVC investments in the automotive industry.

Hypotheses 1: *CVC announcements will generate a significant positive short-term abnormal return for the corporate firm.*

In the recent past, the amount invested by established companies in entrepreneurial ventures has significantly increased (Dushnitsky and Lenox 2006). However, there is little quantitative evidence that those investments create value to the investing firms. As mentioned in the prior section, established firms have other objectives besides financial benefits. Nonetheless, a few studies analyzed the relationship between CVC and the increase in firm value. Dushnitsky and Lenox (2006) analyzed a sample of public U.S firms in the 1990s whether CVC investments create firm value. Firm value was measured by levels of Tobin's q. They report that the likelihood of an increase in firm value only rises when CVC is pursued for strategic reasons. They further state that if a firm actively uses CVC to utilize novel technology it may register innovative advantages. As future work, Dushnitsky and Lenox (2006) promote to further explore value creation of CVC for the acquiring firm, which supports the identified research gap.

2.4 Determinants of CVC Performance

After having reviewed previous research on the motivation and performance of CVC investments, we now analyze how the existing literature explains the performance by analyzing potential factors and characteristics that affect the short-term returns for the investing firms. As there is only little

research done on determinants of CVC announcements, this paper also considers determinants for M&A performances to find similarities and analyze whether results also hold true for CVC investments.

In order to create a direct link to the previous section, the first proposed factor that potentially determines CVC performance is *industry relatedness* between the target and the investor. The likelihood of creating synergies, increases if both companies operate within the same industry. There are several studies related to M&A acquisitions that promote a positive relationship between abnormal returns and industry relatedness (Moeller and Schlingemann 2005; Jose M. Campa and Kedia 2002). This can also hold for CVC investments if shareholders perceive investments into closely related industries as strategic objective to source innovation and utilize novel technology. As Dushnitsky and Lenox (2006) state CVC investments do create firm value when it is perceived for strategic reasons. Therefore, the second hypothesis is:

Hypotheses 2: *CVC investments into targets that are operating in the same industry as the investing firms, will generate positive significant abnormal returns.*

Another factor extensively reviewed by the literature on M&A transactions is the geographic & cultural distance between the acquirer and the target country. Since more distant countries also tend to differ more in culture, this paper expects that cultural and geographic distance tend to be highly correlated. Therefore, we further focus on geographic distance and disregard cultural factors. Studies argue that geographic distance negatively affects the cost of transferring knowledge and technology and that it significantly decreases the success of knowledge-transfer (TIAN, KOU, and ZHANG 2020; Cumming and Dai 2012; Branstetter 2001). As section 2.3 showed, knowledge transfer and the utilization of novel technology are crucial for the exploitation of innovative capacities and the value creation through CVC.

Hypotheses 3: *If the investment target is resident in a geographically distant country, the corporate investor will generate less significant abnormal returns.*

Returns are systematically lower when firms acquire entrepreneurial ventures in which they have previously invested. This may be due to an "over-commitment" to existing portfolio firms (Benson and Ziedonis 2005). In a later study conducted by Benson and Ziedonis (2010) they provide similar evidence on the negative influence of prior investments when corporate investors acquire startups. Consequently, this paper includes another hypothesis to analyze whether these results also hold for further investments instead of full acquisitions.

Hypothesis 4: *Prior investments into an entrepreneurial venture, will generate significant negative abnormal returns.*

As those hypotheses only review potential factors in general, this work will also investigate the influence of the current drivers of the automotive industry. As the automotive industry is driven by radical change and a major transformation process, these trends may lead to significant value for automobile manufacturers in the future. As academic literature on this topic is rather scarce, this paper reviews the research done by large consulting firms. McKinsey&Company; PWC (2016; 2018) outline four major trends with high disruption potential for traditional business models of automobile manufacturers. First, autonomous driving and the associated use of artificial intelligence and big data. Second, digitization and connectivity which will fundamentally change the automotive product itself. Third, electrification and alternative fuels since the demand for electrified powertrains and cheaper batteries will severely increase in the future, also because of regulatory change. And lastly, new mobility solutions such as mobility as a service (MaaS) and on-demand business models as they will gain important market share in the future. Investing in firms focusing on those trends may result in knowledge and technology exchange and can thus be

perceived as strategic objective. In order to incorporate those trends into the regression, the following hypothesis is tested:

Hypothesis 5: *Entrepreneurial targets dealing with the above-mentioned disruptive technologies, will generate significant positive abnormal returns.*

3. Methodology

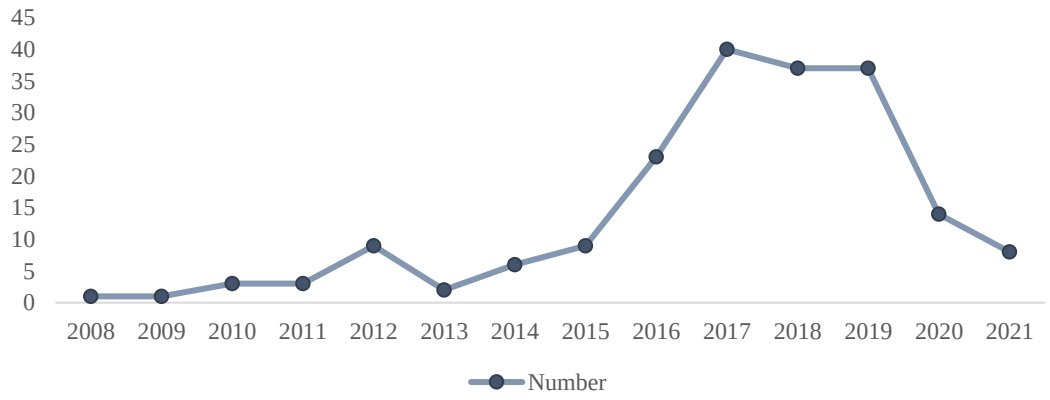
The following section illustrates how the research will be conducted and why. It describes the sample and methodology applied with detailed explanations of the variables incorporated in the regressions. First, the process of the data collection and the sample composition will be presented. Second, the event study methodology which is used to calculate the abnormal and cumulative abnormal returns of each investment will be explained. Lastly, the dependent and independent variables will be described.

3.1 Data Collection & Sample Composition

As presented above, the research of this paper focuses on the investment behavior of publicly listed automobile manufacturers in Germany, Japan, and the United States. Only publicly listed manufacturers are included, since financial information are available to the public and share prices can be collected to calculate abnormal returns. This paper only analyzed automotive manufacturers who completed a minimum of ten investment deals over the period from 2008 to 2021. To obtain all the relevant data, several sources are consulted. To obtain the relevant data on investments, the database ‘Crunchbase.com’ was used. It provides funding size as well as information about the target company, such as geographic location, founding year and a description of the business model. The filter ‘investments’ has been applied to exclude full acquisitions. The daily share prices of the publicly listed automobile manufacturers have been collected from ‘Yahoofinance.com’.

After applying the above-mentioned criteria and excluding investments that did not include the funding size, the total sample contains information about 192 investment transactions. Graph 1 visualizes the number of investments per year. It can be observed that there has been a substantial growth of automotive CVC investments over the last decade. The declining numbers in 2020 were probably influenced from uncertainties of the currently ongoing pandemic.

Graph 1
Number of Investments per Year



3.2 Event Study

An event study methodology is one of the most frequently used financial analysis tools to assess whether there are any abnormal returns earned by shareholders accompanying specific events (earning announcements, M&A announcements, investment announcements).

This paper uses Brown and Warner's (1985) event study methodology to analyze the announcement effects of investments in the automotive industry. This allows us to calculate daily abnormal returns from the event window of each investment. The abnormal returns are computed as the difference between the actual daily return of the investing company and the expected return.

$$AR_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{m,t}$$

The methodology of event studies implicitly assumes that stock markets are efficient. This implies that all investors receive information at the same time. Thus, new information is immediately

incorporated into the stock price. As this paper analyzes the investments of automotive companies operating in the German, American and Japanese markets, it uses the DAX30, S&P500 and the Nikkei225 as reference index. The DAX30 consists of the 30 largest companies in Germany concerning market capitalization. The S&P500 is constituted of the 500 largest American companies and the Nikkei225 with the 225 largest companies on the Tokyo Stock Exchange.

To calculate the expected return for a specific date, event studies imply the use of an event window and an estimation window. The market model regresses stock returns on market returns over the estimation window. By doing this, the relationship between the stock and the reference index is measured in two parameters alpha and beta. Holler (2014) analyzed numerous event studies and discovered that the estimation windows range from 30 to 750 days. Prior studies suggest that results are indifferent from the length of the estimation window given that the window length exceeds 100 days (Armitage 1995; Park 2004). In most cases, the event window ranges from 1 to 11 days symmetrically around the event day (Holler 2014). Oler, Harrison, and Allen (2007) showed that the conventional event window length is 5 days (2 days prior the event date and 2 days after the event date). Hence this paper applies a 5-day event window. For robustness test purposes it also includes a 21-day and 11-day event window. Applying various time windows brings the advantage that it allows to analyze whether results hold over different time windows.

After determining the length of the event windows the cumulative abnormal return (CAR) is calculated as follows:

$$CAR_i = \sum_{t=-2:-5;-10}^{+2;+5;+10} AR_{it}$$

Aggregating the CARs across all firms and event dates yields the cumulative average abnormal returns (CAARs).

$$CAAR = \frac{1}{N}\sum_{k=1}^{N} CAR_i$$

In Section 4.2 the CAARs for the different event windows are being tested for significance.

3.3 OLS Regression

An OLS regression is a commonly used statistical method which measures the influences of independent variables on the dependent variable. In this paper factors for CVC announcement effects are being tested on the outcomes of CARs during the event window. Therefore, the computed CARs serve as the dependent variable. Regarding the independent variables, this paper includes several factors, proposed by the literature. The following regression is constructed as follows:

$$\begin{aligned} CAR_i = \ & \alpha_0 + \beta_i Relatedness\_Dummy_i + \beta_i Geographic\_Distance_i \\ & + \beta_i Prior\_Investment_i + \beta_i Autonomous\_Driving\_Dummy_i \\ & + \beta_i Digitization\_Dummy_i + \beta_i Electrification\_Dummy_i \\ & + \beta_i MaaS\_Dummy_i + \beta_i Age_i + \beta_i Funding\_Size_i + \beta_i Firm\_Size_i \end{aligned}$$

3.3.1 Dependent Variable

CAR – The dependent variable is the estimated 5-day (-2;+2) cumulative abnormal return of publicly listed automotive manufacturers in Germany, Japan, and the United States around the announcement date of CVC investments. To test for robustness, this paper also reveals insights about the 11-day (-5;+5) and 21-day (-10;+10) event windows.

3.3.2 Independent Variables

Industry Relatedness – To examine whether industry relatedness of the investing manufacturer and the venture influences the performance of CVC investments, a dummy variable is included in the regression. If both companies are operating in the same industry, it is coded as 1. If otherwise, it is

coded as 0. Industry relatedness is measured by comparing the first two digits of the companies SIC-Codes, which are obtained from Orbis. A positive relationship between industry relatedness and the announcement of CVC investments is expected since shareholders could perceive investments into closely related industries as strategic objective to source innovation and utilize novel technology (Jose M. Campa and Kedia 2002; Moeller and Schlingemann 2005).

Geographic Distance – This variable measures the distance of both countries involved in the investment deals by calculating the geographic distance (in miles) between the countries' capitals. The larger the geographic distance, the larger the negative effect on knowledge and technology transfer (Branstetter 2001; TIAN, KOU, and ZHANG 2020; Cumming and Dai 2012). Hence, a negative relationship is expected.

Prior Investment – Corporate investors either invest in new entrepreneurial ventures or they further invest in targets which are already part of the portfolio. To measure the influence of prior investments into the target, this paper includes a dummy variable which is coded 1 if the target already has received funding from the corporate and 0 if otherwise. Since prior research found out that companies tend to "over-commit" to portfolio firms when acquiring those, a negative relationship between prior investment and CVC performance is expected (Benson and Ziedonis 2005).

Autonomous Driving & AI – This dummy variable is coded as 1 if the core focus of the entrepreneurial target is on autonomous driving or artificial intelligence. This also includes firms that specialize in sensor and lidar technology, as those are vital for autonomous driving.

Electrification – This dummy variable is coded as 1 if the core focus of the entrepreneurial target is on alternative fuels and electric vehicles. This also includes firms that specialize in battery technology and energy storage.

Digitization & Connectivity – This dummy variable is coded as 1 if the core focus of the entrepreneurial target is on the digitization and connectivity of the car itself.

Mobility as a Service (MaaS) – This dummy variable is coded as 1 if the core focus of the entrepreneurial target is on MaaS solutions.

3.3.3 Control Variables

Age – The age of the entrepreneurial venture can also influence the performance of CVC. The control variable age is included and defined as the years of existing of the venture at the year of fundraising. Since older firms, tend to have a broader set of resources and assets, we expect a positive relationship between age and CARs.

Funding Size – Funding size captures the amount of investment the target received from the investor. It is measured as the logarithm of the amount of funding. This paper expects an increase in CAR if funding size increases.

Firm Size – The control variable firm size measures the market capitalization of the investing automobile manufacturer. It is included to examine whether firm size influences the strategic choices made by companies. It is measured as the logarithm of the market capitalization of the publicly listed investor. A negative sign between CARs and firm size is expected since Moeller, Schlingemann, and Stulz (2004) found out that small firms generate higher abnormal returns than large firms.

4. Results

This section describes the results of the event study and the conducted regressions. The first part shows the descriptive statistics. Second, a correlation analysis is conducted to examine potential multicollinearity issues. Third, the univariate analysis is described and results from the event study are being presented. Lastly, the multivariate analysis of the OLS regression is presented.

4.1 Descriptive Statistics

Table 1 summarizes the descriptive statistics of the dependent, independent and control variables for the OLS regression. First, the CAARs are going to be analyzed. The first observation that can be made is that the CAAR for each event window is positive. The standard deviations decrease as the event window shortens. This results from the reason that the range of values of the period decrease. The smaller minimum and maximum values underline this result. Second, when analyzing the independent variables, it can be found that the mean of industry relatedness suggests that automobile manufacturers tend to invest in companies in a different industry (when considering the first two-digits of the SIC Codes). However, since automobile manufacturers are increasingly investing in technology and software firms this makes sense because those are operating in different industries. The median of the variable geographic distance is 3467,37 miles ($10^{3,54}$) and the maximum is 7413,1 miles ($10^{3,87}$), meaning that the farthest investment was over 7000 miles away. The descriptive statistic for prior investment implies that most of the investment targeted companies which did not receive prior funding from the corporate. Analyzing the trend variable means, it can be observed that entrepreneurial ventures that are focusing on alternative powertrains, electrification, or batteries, received the highest number of funding, followed by ventures focusing on autonomous driving and AI. Third, the control variables of the sample are being analyzed. The mean of the control variable age is 5,51, stating that the targets were on average 5,5 years old at the day of investment. Consequently, for this sample, automobile manufacturers were not exclusively investing in extremely young entrepreneurial ventures. Furthermore, the average funding size is \$36,31 Million ($10^{1,56}$). The smallest amount invested by the automobile manufacturer is \$0,05 Million ($10^{-1,30}$). Firm size of the investing firms measured

in market capitalization averages at $81,28 Billion. The smallest firm is worth $46,77 Billion and the largest $213,8 Billion in market capitalization.

Table 1

Descriptive Statistics

This table summarizes the descriptive statistics for the variables used in the OLS regression. Further information on variables in section 3.3

Dependent, Independent and Control Variables								
Dependent Variables								
	Mean	SD	Min	Median	Max	Skewness	Kurtosis	N
CAAR (-2,+2) (%)	0,4%	2,8%	-8,2%	0,4%	14,5%	1,23	5,90	192
CAAR (-5,+5) (%)	0,7%	4,1%	-8,8%	0,4%	16,9%	0,74	1,86	192
CAAR (-10;+10) (%)	1,3%	6,6%	-11,5%	1,0%	26,5%	0,77	1,33	192
Independent and Control Variables								
	Mean	SD	Min	Median	Max	Skewness	Kurtosis	N
Industry Relatedness	0,28	0,03	0,00	0,00	1,00	0,98	-1,05	192
Geographic Distance	2,22	0,12	0,00	3,54	3,87	-0,49	-1,72	192
Prior Investment	0,24	0,03	0,00	0,00	1,00	1,20	-0,57	192
Autonomous Driving & AI	0,19	0,03	0,00	0,00	1,00	1,57	0,47	192
Electrification	0,22	0,03	0,00	0,00	1,00	1,37	-0,12	192
Digitization	0,18	0,03	0,00	0,00	1,00	1,66	0,76	192
MaaS	0,17	0,03	0,00	0,00	1,00	1,80	1,26	192
Age	5,51	0,29	0,00	5,00	33,00	2,43	11,86	192
Funding Size	1,56	0,06	-1,30	1,44	3,53	0,11	0,27	192
Firm Size	1,91	0,01	1,67	1,91	2,33	0,85	-0,21	192

4.2 Correlation Analysis

Appendix 2 displays the correlations for the independent and control variables of the regression. The matrix depicts the correlation between all the possible pairs of values in a table and determines the correlation coefficients between the variables in our sample. If the coefficient is +1, a positive correlation exists, while if the coefficient is -1, a negative correlation exists. For our sample, the correlation coefficient for the variables industry relatedness and autonomous driving reports +0,706, thus showing a strong relationship between those two variables. Given that automobile manufacturers primarily tend to invest in industry-related companies, which are also more

dedicated to the topic of autonomous driving and artificial intelligence, the observed correlation was slightly expected. For the rest of the sample, rather positive nor negative high correlations can be observed. However, to test whether the high positive correlation between industry relatedness and autonomous driving poses a multicollinearity problem in the regression, the variance inflation factors (VIF) are calculated. To exclude potential multicollinearity problems, the VIFs need to be lower than 10 (Hair, JR. et al. 1995). Since all variables of the sample have a ViF score clearly below 10, no variables need to be excluded from the regression (Appendix 3).

4.3 Univariate Analysis

Based on the methodology in section 3.3, this section displays the results of the performed event studies which calculated cumulative average abnormal returns (CAARs) over the 5-Day, 11-Day, and 21-Day event window. The daily average abnormal returns (AARs) which are calculated for each investment and for every day within the event window, are analyzed in Graph 2. Automobile manufacturers experience a strong increase in abnormal returns before the announcement date of the deals. It can be further observed that the abnormal returns have their peak on the day of announcement. However, the graph depicts that abnormal returns strongly decrease in the following two days after the announcement day.

Graph 2
5-Day Event Window

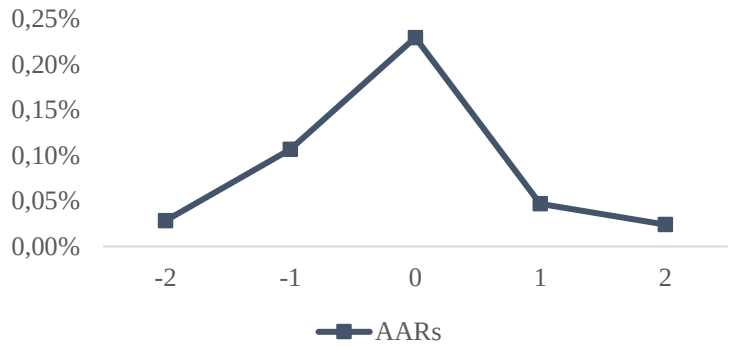


Table 1 summarizes the results from the performed event study. It reports the CAARs of the three event windows and their respective significance tests. The findings show that automobile manufacturers have statistically significant cumulative abnormal returns for the 5-Day and the 11-Day event window at the 5% level. The 21-Day event window shows statistically significant CAARs at the 1% level. The 5-Day CAAR is 0,43%, thus automobile manufacturers could report a 0,43% abnormal return over a period of 2 days prior until 2 days after the investment announcement date. The 11-Day CAAR accounts for 0,74% and the 21-DAY CAAR for 1,32%. Consequently, automobile manufacturers benefit from short-term returns over all the observed event windows.

Table 1

Univariate Analysis

This table summarizes the CAARs of the automobile manufacturers. Three event windows have been applied (-2;+2), (-5;+5), (-10;+10). Test statistics have been calculated to analyze whether results are statistically significant.

Event Study			
Event Window	CAAR	t-test	Sig.
CAAR (-2;+2)	0,0043	2,1950	**
CAAR (-5;+5)	0,0074	2,5210	**
CAAR (-10;+10)	0,0132	2,7558	***
N	192		

***, **, * indicate statistical significance at 1%, 5%, 10% levels

4.4 Multivariate Analysis

In the last section, the univariate analysis showed that automobile manufacturers can expect positive abnormal returns during the observed event window. The next section provides insights into the relationship between the CARs and prior investment as well as industry and geographic characteristics. This paper further studies the potential relations between the abnormal returns and the currently driving trends of the automobile industry. The results of the regressions are reported in Table 2. As Oler, Harrison, and Allen (2007) suggested, the regression is performed on a 5-Day

event window. However, the regressions for the 11-Day and 21-Day event windows are also performed for robustness purposes and to examine whether results hold over different time periods. First, the independent variables are being analyzed. We do not find statistical significance in all three event windows for the industry relatedness dummy. This suggests that in our sample industry relatedness does not have an influence on abnormal returns. The geographic distance variable shows a negative statistically significant coefficient at the 5% level for the 5-Day event window and at the 1% level for the 11-Day and 21-Day event window. Hence, an increase in geographic distance negatively affects the CAARs of automobile manufacturers. Although the prior investment dummy is statistically insignificant for the 5-Day and 11-Day event window, it is found to be significant for the 21-Day event window at the 1% level. As for all the four trend variables, the regressions report high positive significance levels over all three event windows. Only entrepreneurial ventures focusing on autonomous driving and AI technology do not show any significance at the 21-Day event window. Therefore, automobile manufacturers positively react to investment announcements of ventures which business models are tackling the current trends. Second, the relationship between the CAAR and the control variables is being examined. The variable which measures funding size is found to be statistically insignificant at all three event windows when observing the 1%, 5% and 10% levels. However, it shows low negative significance at the 15% level. As this observed significance is not sufficient, we do not further consider it. The firm size variable is positively significant for the 5-Day event window at the 10% level, while it is insignificant at the other two event windows. This implies that investments from larger investing automobile firms yield positive abnormal returns over the 5-Day event period. Finally, the age variable within the sample reports no significance over all three event windows.

Table 2

OLS Regression

This table reports the results for the Ordinary Least Squares regression. The dependent variable of the first regression is the 5-Day CAAR. The second and third with 11-Day and 21-Day CAAR, respectively.

Regression Analysis			
Independent Variables	CAAR (-2;+2)	CAAR (-5;+5)	CAAR (-10;+10)
Industry Relatedness	-0,001	-0,001	-0,008
	(0,006)	(0,009)	(0,015)
Geographic Distance	-0,002**	-0,006***	-0,008***
	(0,001)	(0,002)	(0,003)
Prior Investment	0,002	-0,005	-0,030***
	(0,005)	(0,007)	(0,011)
Autonomous Driving & AI	0,021***	0,023**	0,024
	(0,006)	(0,009)	(0,015)
Electrification	0,018**	0,025**	0,047***
	(0,008)	(0,011)	(0,018)
Digitization & Connectivity	0,017***	0,036***	0,053***
	(0,006)	(0,009)	(0,015)
MaaS	0,017***	0,031***	0,043***
	(0,006)	(0,009)	(0,015)
Control Variables			
Funding Size	-0,004	-0,003	-0,005
	(0,003)	(0,004)	(0,006)
Firm Size	0,018*	0,012	-0,016
	(0,010)	(0,015)	(0,024)
Age	0,000	0,000	0,000
	(0,001)	(0,001)	(0,001)
Observations	192	192	192
R^2	0,100	0,127	0,143

5. Discussion

This chapter discusses the main findings of the univariate and multivariate analyses by comparing the results to the existing literature on CVC & M&A investment announcements. Furthermore, the above developed hypotheses are being reviewed. The previously conducted event studies show that CVC investments are indeed creating short-term abnormal returns for automobile manufacturers.

The CAARs obtained from the univariate analysis are statistically significant and positive over all three observed event windows. At first sight, these findings contradict the prior literature on M&A announcements, namely as outlined in chapter 2.2, Fuller, Netter, and Stegemoller; José Manuel Campa and Hernando (2002; 2004) found out that only target firms benefit from M&A announcement effects and acquirers perceive zero to even negative returns. However, our findings align with two specific studies about M&A announcement effects in the automotive industry from Laabs and Schiereck; Mentz and Schiereck (2010; 2008) as they report positive short-term wealth effects for acquiring automotive companies. Consequently, manufacturers benefit from short-term abnormal returns when investing in entrepreneurial ventures. In Hypothesis 1, the assumption was made that automotive manufacturers receive positive returns from CVC investments. Since all three regressions posed significant results, Hypothesis 1 is supported.

The results obtained from the multivariate analysis, enable us to partially explain the above mentioned positive short-term wealth effects. The dummy variable industry relatedness does not show any statistical significance in the observed three event windows. As outlined in Chapter 2, the likelihood of creating synergies, increases if both companies operate within the same industry. There are several studies related to M&A acquisitions that promote a positive relationship between abnormal returns and industry relatedness (Moeller and Schlingemann 2005; Jose M. Campa and Kedia 2002). Hypothesis 2 tested if those findings also hold for CVC investments and proposed that investing automotive firms generate greater abnormal returns when targeting industry related ventures. Since our findings do not align with the findings from the literature, we are unable to support the second hypothesis.

We find negative statistically significant coefficients for the geographic distance variable over all three event windows. This implies that the higher the distance between the investing firm and the venture, the lower the abnormal return for the investing firm. Previous studies argue that

geographic distance negatively affects the knowledge and technology transfer (Cumming and Dai 2012; Branstetter 2001). As section 2.3 showed, knowledge transfer and the utilization of novel technology are crucial for the exploitation of innovative capacities and the value creation through CVC. Those findings support our results as in all performed regressions, the variable geographic distance showed negative and highly statistically significant values. Therefore, we support the third hypothesis.

Our results further suggest that prior investment into the venture does not affect the abnormal returns to automotive manufacturers. This is contrary to findings from the literature which examined the effect of prior investments and the acquisition of portfolio firms. Those studies found a negative relationship between prior investment and acquiring portfolio firms. Yet, in our regression, we only find negative significances between prior investment and lower abnormal returns in the 21-Day event window. As this paper focuses on the 5-Day event window, we do not further consider this finding and are unable to support the fourth hypothesis.

The theoretical rationale of researching the four industry trends autonomous driving & AI, electrification, digitization, and Mobility as a Service (MaaS) is that those are currently the drivers of the automotive industry, thus we are expecting that ventures focusing on those trends generate positive abnormal returns for investing firms. Except for the dummy autonomous driving at the 21-Day event window, we find positive statistically significant results for all four trends. This implies that the targets which are tackling the current trends generate positive abnormal returns for automotive manufacturers. As McKinsey&Company (2016) proposed, automobile manufacturers need to heavily invest in those trends to exchange knowledge, leverage new technology and stay competitive in the future. Our findings underline these recommendations for automotive manufacturers. Investments in entrepreneurial ventures dealing with autonomous driving,

electrification, digitization and MaaS do not only generate short-term abnormal return, as found out in this paper, but also prepare those firms strategically for the future.

6. Conclusion

Various studies examined the effect of M&A announcements on the returns for acquirers and target firms. However little research attributes to whether CVC investments create value for the investing manufacturers in the automotive industry and if so, what are the determinants behind this value creation. Therefore, this study developed two research questions:

1. *Do CVC announcements in the automotive industry influence the short-term abnormal returns of the investing company?*
2. *Which factors influence the short-term abnormal returns for investing companies in the automotive industry?*

To answer the research questions an event study and a multivariate analysis have been performed. The analyzed sample included 192 investments into entrepreneurial ventures conducted by automotive manufacturers from Germany, Japan, and the United States. First, the short-term effects of the investing firms around the transaction announcement date were examined. This study followed the event study methodology by Brown and Warner (1985). Thereafter, an OLS regression was performed, to analyze potential effects of certain industry, geographic and trend characteristics on the abnormal returns of investing firms, while controlling for firm size, age, and funding size. The event study revealed that automotive manufacturers generate positive abnormal returns over several event windows when announcing CVC investments. Hence, the first research question can be confirmed.

The results from the multivariate analysis found out that greater geographic distance generates significant negative abnormal returns for investing automotive manufacturers. This aligned with

prior research since greater geographic hampers knowledge and technology exchange. These results were robust over all three event windows. All four tested automotive industry trends showed high positive significance and underline the current transformation of the industry. To answer the second research question, it can be concluded that geographic distance, automotive industry trends and firm size of the investing firm influence the short-term abnormal return of automotive manufacturers.

To conclude, this paper contributes several important insights into the raising relevance of CVC literature, especially within the automotive industry. First, positive statistically significant abnormal returns for investing automotive manufacturers were found over a relatively long- and recent-time horizon. Second, targets in more distant geographic locations generate more negative abnormal returns. Finally, this work reveals the importance of the ongoing trends of the automotive industry and their relevance for traditional automotive manufacturers. These trends pose an opportunity to adapt the current business model, access new knowledge and stay competitive in the future.

6.1 Limitations

This paper is based on several assumptions that could induce limitations. First, by applying the event study methodology, this work assumes that capital markets are efficient and newly released public information is directly integrated into the prices of stocks. Second, only publicly listed companies were included which is due to the necessity to obtain the stock prices for the event study methodology. Third, this work focused on automotive manufacturers. These companies further are located in Germany, Japan and the United States which poses another limitation. Companies from different locations or different industries might have performed differently when engaging in CVC investments. Third, only the short-term abnormal returns were measured. Additionally, this study

did not perform a long-term analysis on how these investments affect shareholder returns of the investing firms. For instance, a positive short-term abnormal return does not guarantee a long-term value creation for the investing firm.

Concluding, a larger dataset, a different industry or a longer time horizon could have led to different outcomes of this study.

6.2 Future Research

Since little research has been done on this topic so far, the results promote further opportunities for investigations. First, while this paper only focused on the performance of investing firms, future research could also analyze target firms and their involvement in CVC. The results could be compared to entrepreneurial ventures backed by traditional VC funds. Second, following the limitations, future research could examine whether these results hold in the long run. This would be of certain interest to long-term shareholders, since synergies, knowledge and technology transfer improve in the long run. Third, the sample could be adjusted or enlarged. Another industry or more deals from a different location could result in different findings. Thus, proposing another future research opportunity. Finally, the development of entrepreneurial ventures after the investment could be investigated to create further recommendations for future deals.

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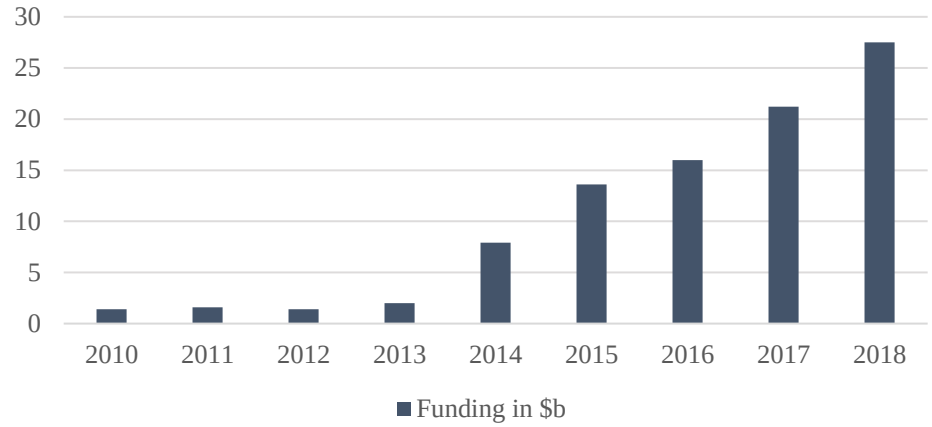
Appendix

Appendix 1
Annual automotive startup funding worldwide from 2010 to 2018



Source: (Statista 2019)

Appendix 2
Correlations

This table provides the correlation between the independent and control variables incorporated in the regressions.

Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) Industry Relatedness	1,000									
(2) Geographic Distance	-0,123	1,000								
(3) Prior Investment	0,210	-0,038	1,000							
(4) Autonomous Driving & AI	-0,188	0,087	-0,063	1,000						
(5) Electrification	0,706	-0,129	0,168	-0,259	1,000					
(6) Digitization	-0,055	0,112	-0,018	-0,231	-0,250	1,000				
(7) MaaS	-0,280	0,147	0,038	-0,218	-0,237	-0,211	1,000			
(8) Age	0,353	-0,146	0,212	-0,109	0,314	-0,128	-0,103	1,000		
(9) Funding Size	0,070	0,129	0,206	0,238	0,122	-0,157	0,043	0,143	1,000	
(10) Firm Size	-0,164	0,010	-0,046	-0,008	-0,079	-0,237	0,109	0,059	0,128	1,000

Appendix 3

This table lists the ViF scores for the independent variables of the regression.

Independent Variables	**ViF**
(1) Industry Relatedness	2,231
(2) Geographic Distance	1,108
(3) Prior Investment	1,124
(4) Autonomous Driving & AI	1,694
(5) Electrification	2,645
(6) Digitization	1,645
(7) MaaS	1,546
(8) Age	1,233
(9) Funding Size	1,238
(10) Firm Size	1,134