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Impact of CEO Overconfidence on M&A Performance in the US: A Content Analysis

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Abstract

Despite the high activity on the market for corporate control, more than 60% of M&As are unsuccessful and contribute to damage to the value of the acquiring company. We still have little evidence on the impact of M&A deals in different countries and industries on shareholer value, as well as the factors that influence this impact. Academic researchers and practitioners continue to seek out the factors that influence M&A performance, but results are still inconclusive, indicating the need for further research into acquisition performance and factors that influence the overall success of M&A deals. This paper examines the impact of CEO overconfidence on the performance of M&A deals in the United States. In contrast to previous studies, we, first of all, use earnings call transcripts in content analysis as the base to measure CEO overconfidence; secondly, we apply cluster analysis to identify the factors that force CEOs to structure their speech during earnings calls in a similar manner; and, thirdly, we assess the impact of CEO overconfidence on the performance of high-tech deals. The study is based on a sample of 492 M&A transactions implemented during the post-crisis period, 2009–2019. Using the event study method to assess the performance of M&A deals and regression analysis, we prove that CEO overconfidence has a negative impact on the success of M&As. However, when considering a subsample of deals in which the target company operates in a high-tech industry, we failed to identify a significant impact of overconfidence on M&A performance. As a result of cluster analysis, we identified a cluster of 165 companies with a common structure and similarity of CEO speeches, which are not explained by the companies' affiliation with similar industries. This suggests that overconfident CEOs tend to use and structure their speeches similarly.

Keywords: CEO overconfidence, M&A deals, speech tone, event study, high-tech deals, content analysis

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Introduction

Traditional approaches to strategic deal research assume that a company's top management analyses and then plans a future deal based on rational considerations. We move from the traditional financial paradigm in analysing M&A deal performance to behavioural effects, focusing on the performance of M&A deals driven by economic agents whose behaviour does not conform to the assumption of rationality. More precisely, we focus on overconfidence, the tendency of people to think they are better than they really are with respect to characteristics such as ability, judgment, or prospects for a successful life outcome [1] and examine its influence on M&A performance. Overconfidence has long been popular as an explanation for failed mergers. R. Roll [2] first formalized this concept, and subsequent researchers have continued to study the effects of CEO overconfidence on M&As, indicating in most cases that CEOs with such a characteristic tend to increase the frequency of M&As and negatively affect the performance of the deals [3–7].

In this paper we employ content analysis to measure the CEO overconfidence, which is new in the field of assessing its effects on value creation for shareholders in M&As. Today, sentiment analysis embedded in various sources of corporate information is widely used in behavioral finance. Content analysis makes it easy to analyze sentiment and tone in financial documents, press articles, press-releases, social media networks, etc., using embedded dictionaries. It allows to gain a deeper understanding of the incentives and perspectives underlying managers' and boards' activities related to M&As. We use semantic analysis of the texts of annual earnings conference call transcripts. Although most researchers prefer to use financial reports and letters to shareholders, we believe that the transcripts of earnings calls are the best tool for the analysis as they provide a record of live communication between the CEO, other top managers, and external participants.

Our paper also contributes by using machine learning tools and cluster analysis to identify the behavioral aspects of the CEO's speech during quarterly earnings calls and to identify factors that determine common trends in CEO behavior and speech during these conference calls.

Additionally, we contribute to the existing research by assessing the impact of CEO overconfidence on the performance of high-tech M&As. Since 1990, there has been a substantial increase in M&A activity in high-tech industries due to the need to acquire firms to obtain new skills and new technical and technological knowledge [8]. Nowadays we observe impressive activity in acquisitions of innovative firms. The technology sector is becoming the key sector today in terms of volume and number of M&A deals. Behavioral finance literature reveals that overconfident CEOs are risk-taking persons who are confident in their efforts, have a greater tendency towards innovation and prefer to make deals with targets from high-tech industries. If the acquired innovation is successful, it can offset the observed negative effect of CEO overconfidence. But innovations are challenging, time-consuming and risky and may not translate into the higher firm value. In our paper we try to understand whether high-tech M&As are successful when initiated by overconfident CEOs.

The remainder of the paper is structured as follows. The literature review section discusses the measures of CEO overconfidence in M&As, focusing on content analysis; presents the results of recent empirical research on the effect of CEO overconfidence on M&A performance; and sets forth the hypotheses. The methodology section describes the measure of CEO overconfidence, CEO clustering method and the variables used in the empirical analysis and shows the criteria for the sample selection procedure. The penultimate section provides a discussion of the results, and the last section concludes the paper.

Literature Review

Measures of CEO overconfidence in M&As

Overconfidence is defined as an overestimation of one's own abilities and of outcomes related to one's personal situation (the "better-than-average" effect) [9]. In other words, managers assess themselves as being better than the average, explaining that they have skills and experience inherent only to them [10]. Overconfident CEOs usually overestimate the mean returns on investment projects and underestimate risk probability.

The challenging part in exploring CEO behavioral patterns and the influence on M&A deals is to find the most unbiased methodology of measuring CEO overconfidence. The analysis of academic literature allows us to single out various proxies for CEO overconfidence (Table 1). Some of them are more popular, such as CEO stock options [3; 10], content analysis [1; 3], the net buyer measure [10], while others, such as the relative compensation, recent organizational performance, frequent acquirers and synergies forecast error [7], are used less frequently. Among these various techniques, content analysis is currently gaining popularity. Content analysis itself comprises two main methods. The first one is based on the CEO's image in the media. The idea of this method is to search for certain keywords in press articles, interviews with CEOs and references to them in social networks. The CEO is considered overconfident if the number of references in press about him/her as an "overconfident individual" exceeds the number of references as "conservative and cautious" [3]. This method has certain shortcomings, such as extreme subjectivity in media assessments, which can be attributed to the willingness to create a negative public image of a particular CEO for various reasons. Moreover "press coverage suffers from an important endogeneity problem: mergers may change the tenor of press coverage. The press may perceive acquiring CEOs as more confident, or managers may try to convey confidence during acquisition bids" [3].

The second new measure of CEO overconfidence in the M&A sphere involves examining the CEO's speech to identify the overconfident tone. P. Garrard et al. [11] defined

a close connection between individual linguistic features and cognitive biases. From the viewpoint of psychology, D.M. Merkl-Davies and N.M. Brennan [12] found out that overoptimism and strong confidence of the CEO's tone of the speech is an indicator of overconfidence. They also mentioned that the analysis of CEO's speech is the most objective tool to estimate the true level of CEO overconfidence [12]. The object of the analysis are the words spoken by the CEO. The researchers often use CEO tweets, management earnings forecasts [13]; letters to shareholders [14]; earnings press release – MD&A section, 10-K or 10-Q filings [15], whereas earnings call transcripts seem to be more suitable for content analysis [12]. Earnings calls consist of the company's quarterly results, forecasts and a Q&A session, which is the largest part of the transcript. Therefore, a transcript of an earnings call, which is a live communication, creates an opportunity to evaluate the specifics of CEO behavior more precisely. The CEO has little control over the tone of his/her speech, in contrast to, for example, the text of a letter to shareholders written and edited in advance. The content analysis of CEOs' quarterly earnings calls, known as the "bag of words" method, contributes to the detection of the so-called overconfident tone [16].

By analyzing the content of earnings call transcripts, machine learning tools provide an opportunity to conduct a deeper content analysis and divide the sample into certain clusters for further analysis and identification of factors that unite particular CEOs. Clustering provides an opportunity to thoroughly analyze earnings call transcripts and find the specifics of CEO speech construction and factors that affect the speech tone. Clustering analysis is important in that it can demonstrate that company-specific and personal factors, rather than only industry-specific factors, influence the CEO's speech structure and behavior. For example, all CEOs of pharmaceutical companies can be expected to discuss R&D expenses, whereas high-tech company CEOs discuss only technological innovations. It means that the CEOs are grouped (clustered) based on the industry specific characteristics, as during earning calls they discuss issues related to their industry of operation. However, *we expect that CEOs' speech structure is not industry-specific only, but is related to his/her personal and company characteristics.*

CEO Overconfidence and M&A deals

The hubris hypothesis proposed by R. Roll [2] suggests that company decision makers tend to overestimate their own abilities when making M&A decisions. In other words, the decision to merge is explained only by the irrational behavior of the acquiring company's management and the belief that only they are capable of identifying synergistic merger opportunities that are unobservable to others. Thus, in subsequent studies CEO overconfidence has come to be considered one of the factors explaining the activity and performance of M&A deals. The impact of CEO overconfidence on M&A outcomes has attracted the attention of many researchers. The results of empirical papers demonstrate that overconfident CEOs are more likely to initiate deals when their company has internal financing sources; usually prefer to undertake diversifying deals; and tend to make more M&As than rationality-driven managers, who on average create significantly lower value for acquirer's shareholders [3; 6; 7]. The empirical papers that examine the impact of CEO overconfidence on M&A performance are summarized in Table 1.

Table 1. CEO overconfidence and its impact on M&A performance

Authors and year of publication	Sample	Measurement of CEO overconfidence	Results	Direction of the CEO overconfidence impact on M&A performance
U. Malmendie, G. Tate, 2008 [3]	477 large publicly-traded U.S. firms, over 1980 to 1994	1.Option-based method; 2. CEO press portrayal	The market reacts much more negatively to the announcement of M&A deals initiated by overconfident than non-overconfident CEOs	–
J.A. Doukas, D. Petmezas, 2007 [17]	5334 successful acquisitions by U.K. public companies, over 1980–2004	Option-based method	Overconfident bidders create positive announcement returns, but they are considerably lower than the returns realized by non-overconfident bidders	–
R. Brown, N. Sarma, 2007 [4]	312 Australian firms, over 1994–2003	CEO press portrayal	1. CEO overconfidence is significant in the explanation of the acquisition decision; 2. Effective corporate governance, as measured by a higher proportion of independent directors on the board, significantly mitigates CEO overconfidence	+/–

Authors and year of publication	Sample	Measurement of CEO overconfidence	Results	Direction of the CEO overconfidence impact on M&A performance
A.C. Kolasinski, X. Li, 2013 [5]	15,204 US firm-year observations over 1988–2006	Option-based method	Acquisitions initiated by overconfident CEOs tend to be more value destroying than the deals made by non-overconfident CEOs	-
H. Hwang et al., 2020 [6]	13,754 US firm-year observations over 1996–2014	Option-based method	Power-led overconfident CEOs tend to make more M&As, use stocks to pay for the deals, and make diversifying M&As	-
I. Skvortsova, A. Vershinina, 2021 [18]	237 M&A deals closed by Russian firms over 2005–2019	1. the company's current performance 2. CEO prior professional experience	1.CEO overconfidence destroys value 2. All corporate governance mechanisms can mitigate CEO irrationalities in M&A	-
A. Ismail, C.P. Mavis, 2022 [7]	497 US deals over 1993–2013	Synergies forecast error	CEO overconfidence is positively related to M&A premium and negatively related to abnormal returns on the bidder's stock	-

Table 1 shows that almost all the researchers prove the negative impact of CEO overconfidence on M&A performance, suggesting that overconfident CEOs usually over-estimate their ability to generate returns, and, as a result, overpay for target firms and undertake value-destroying deals. But how can this negative effect of CEO overconfidence be neutralized? R. Brown and N. Sarma [4] show that the higher the proportion of independent directors on the board, the lower the effect of CEO overconfidence and, consequently, the lower the probability of company participation in M&As. A.C. Kolasinski and X. Li [5] also conclude that strong and independent boards restrain M&As driven by CEO overconfidence. R.W. Masulis et al. [19] argue that separation of the positions of CEO and chairman could mitigate CEOs' empire-building and force them to be more selective in their M&A decisions, leading to increased value for shareholders. Previous unsuccessful experience as a factor influencing the decrease in CEO overconfidence was considered only by A.C. Kolasinski and X. Li [5]. The authors consider negative experience in terms of realized losses from an insider purchase and find that once-overconfident CEOs make better acquisition decisions after they experience personal stock trading losses.

Table 1 also indicates that researchers mostly prove the negative impact of CEO overconfidence on M&A performance for companies in developed capital markets, such as the USA, UK, and Australia, and there is only one paper that addresses this question in an emerging capital market and also proves the negative effects of CEO overconfidence for Russian firms. Following the arguments of the previous authors, we also expect that:

H_1: CEO overconfidence has a negative impact on the M&A performance of US companies

CEO overconfidence and the performance of high-tech M&As

Nowadays, a striking trend on the corporate control market are M&A deals aimed at business digitalization, and the purchase of technologies and innovations. The technology, media & telecommunications (TMT) sector is now becoming the key sector in terms of the volume and number of transactions on the global market. The digitalization of the economy is intensifying companies' efforts to digitalize their products and services and is generally stimulating them to raise their technological level. M&A deals continue to be the fastest and least expensive way to gain access to competitive technology compared to building and developing a proprietary base. Considering the abovementioned factors, it is vital to understand how CEO overconfidence impacts M&A performance in this market.

Behavioral finance literature states that overconfident CEOs are risk-taking and prefer to make deals with targets from innovative (high-tech) industries [1]. It is widely known that innovation is challenging, time-consuming and risky. The closing of high-tech M&A deals is considered as an indicator of superior future-oriented "vision." Therefore, researchers stated that overconfident CEOs tend to conduct such M&A deals more frequently [1]. Using a sample of US firms over 1980–1994, A. Galasso and T.S. Simcoe [20] also show that overconfident CEOs are more likely to initiate a significant change in their firm's innovation strategy and have greater flexibility to make changes in their firm's strategic direction. On the other hand, D. Hirshleifer et al. [1], empirically prove that firms with overconfident CEOs have higher stock return volatility on a sample of US firms over 1986–2003. Overconfident CEOs invest more heavily in R&D and achieve greater innovation as measured by

patent and citation count, but the greater innovative output for given R&D input achieved by overconfident CEOs does not necessarily translate into higher firm value. From the other side , A. Galasso and T.S. Simcoe [20] show that there is a positive relationship between CEO overconfidence and firm's value. E. Karnoukhova and A. Stepanova [21] also find that powerful CEOs positively contribute to the performance of high-tech companies. Considering these arguments and the fact that in most cases stock market reacts positively to the accouchements of high-tech M&As, we hypothesize that:

H_2: CEO overconfidence has a positive impact on the high-tech M&A performance of the US companies

Methodology

Overconfidence measurement

To identify the "overconfident tone" of the CEO, content analysis of the earnings calls' transcripts is used. For content analysis purposes, quarterly earnings call transcripts of the sample companies for the period prior to the M&A transaction were downloaded from the S&P Capital IQ database with subsequent data processing. Research in psychology and finance proves that overconfident people tend to use more positive and confident words than negative and uncertain ones [12; 15]. For that reason, T. Loughran and B. McDonald [15] developed a dictionary based on the Harvard business school's dictionary of positive, negative and other word tints. Besides that, the dictionary is constantly updated by T. Loughran and B. McDonald. As of May 2020, T. Loughran and B. McDonald divide the list of 3052 words into positive, negative, strong, and weak modals categories[1]. Table 2 provides the examples of the words on the list.

Table 2. Examples of words from T. Loughran and B. McDonald's dictionary

Positive	achieve, benefit, boost, confident, delight, encourage, enjoy, outperform
Negative	abandon, bribe, complain, dissatisfy, exaggerate, imbalance, misappropriate, suffer
Uncertain	approximately, doubt, instability, risk, volatility
Strong modal	always, best, definitely, must, strong
Weak modal	almost, could, depend, possibly, suggest

To calculate the proxy of overconfidence, which is the overconfident tone, a continuous variable reflecting the degree of CEO's overconfidence tone is built:

$$\text{Overconfidence tone} = \frac{(\text{Positive} + \text{Strong Modal}) - (\text{Negative} + \text{Uncertain} + \text{Weak Modal})}{\text{Total number of words}}. \quad (1)$$

Overconfidence tone measurement means that the higher is the indicator, the higher is the overconfidence level of the particular CEO. The logic of using the abovementioned formula is that the relationship of words with different tones to the sum of total number of words in the earnings call transcript describes the CEO's speech tone and indicates the presence of overconfidence if it is larger than zero. It means that the usage of the formula shown above indicates a CEOs' way of presenting call participants with almost the same content by using different sets of words (different dictionary) [15].

Due to the large volume of the earnings call transcripts, data science tools are used. For that reason, Python programming language is applied to calculate the overconfident tone. Python allows to analyze a large amount of data in a very short time and provide an output of calculation. The Python script of overconfidence calculation is presented in the Appendix. The written script aims to identify the words from the dictionary list with the tone consideration in the earning call transcripts. If a word in the report coincides with the word that is in the dictionary list, the program identifies the category to which a particular word belongs and goes through the whole transcript, providing the overconfidence tone indicator at the end.

CEO clustering method

The novelty of this study is the use of advanced machine learning tools to cluster CEOs and identify similarities that bring them into a single cluster. To use this tool effectively, the sample was divided into four groups. Dividing them into four groups allows to separate them subsequently into several clusters and find the one that helps explain the characteristics inherent in the CEOs of a given cluster. For this purpose, the first group is divided into two clusters, the second – into three, the third – into four, and the fourth – into five. The aim is to find a cluster that ranks companies by factors other than industry. After that, further steps are needed to manually identify all possible factors.

[1] URL: https://sraf.nd.edu/textual-analysis/resources/

To do this, the sample is initially divided into two separate clusters with no analysis attributes other than industry affiliation. A similar scenario takes place in the case of the third and fourth clusters. When the sample is divided into five clusters, it is revealed that the group of 165 companies is unified by factors other than industry. Manual analysis and the Python programming language were used to find these factors. The main purpose of using this method is to identify the factors that lead to this common behavior and motivate CEOs to use a similar communication style during calls, thereby giving a new direction to the literature on CEO behavior analysis.

M&A performance measurement

To estimate the performance of M&A deals, we apply the standard event study method. Normal (predicted) returns are generated using the market model:

$$R_{jt} = \alpha_j + \beta_j R_{mt} + \varepsilon_{jt}, \quad (2)$$

where R_m is the return on a market index (S&P 500) on day t; β_j measures the sensitivity of firm j to the market; α_j measures the mean return over the period that is not explained by the market; $t \in (t_1; t_n)$ is the estimation period, ε_{jt} is the statistical error; $E(\varepsilon_{jt}) = 0, \text{var}(\varepsilon_{jt}) = \sigma^2$.

The abnormal return here is

$$AR_{j\tau} = R_{j\tau} - \hat{\alpha}_j + \hat{\beta}_j R_{m\tau} \quad (3)$$

where, $R_{j\tau}$ is the actual return, $\epsilon(T_1; T_m)$ is the event window.

We employ a 3-day (−1; +1) and 11-day (−5; +5) event windows to calculate cumulative abnormal returns (CARs) [22]. We take 255 trading days prior to the event window as the estimation period to calculate the predicted return for each firm.

The general test used for all hypotheses is the following [23; 24]:

$$H_0 : CAR = 0$$

Test statistics are defined as follows:

$$t = \frac{CAR(T_1; T_m)}{\sqrt{m\delta^2(t_1; t_n)}}, \text{ where } \delta^2(t_1; t_n) = \sum_{t=t_1}^{t_n} \delta^2(AR_t), \quad (4)$$

where m is the length of the event window.

CEO overconfidence and M&A performance

The next step in our analysis is to understand the impact of CEO overconfidence on the M&A performance. For that purpose, the following ordinary least squares (OLS) regression is used[2]:

CAR=β_0+β_1 Overconfidence+ β_2 Total revenue 3-year CAGR+β_3 Log(firm size)+β_4 CEO age+β_5 Education dummy+β_6 Difference tenure and year of transaction+β_7 GDP growth rate. (5)

The dependent variable is cumulative abnormal return (CAR) for a single deal, which is explained by the independent variable, CEO overconfidence, and a set of control variables:

3-year total revenue compounded annual growth rate: the level of the acquirer's revenue growth in the 3 years prior to the year of the M&A deal announcement.

Log firm size: the total value of assets for the year before the transaction.

CEO age: the age of the CEO at the moment of M&A deal.

CEO education dummy: 1 if CEO has an MBA, JD or PhD degree, and 0 otherwise

Difference between tenure and year of transaction: the variable shows the length of the CEO's management period prior to the transaction date.

Quarterly GDP growth rate: the variable forms overall market's expectations towards its growth or decline, which affects the market reaction to M&A deals.

The summary statistics of the final model's explanatory variables and the dependent variable is presented in the Appendix.

Data

The timeframe of the deals is between 2009 and 2019. Thus, we examine the period after the 2008–2009 crisis and before the COVID-19 pandemic.

We use the S&P Capital IQ and BoardEx databases to identify an initial sample of publicly traded deals and to download information about the personal characteristics of executives and board of directors. We further require that (1) a deal results in acquisition of the majority stake – at least 50% + 1, (2) both an acquirer and a target are not from financial or utilities sectors – exclusion is based on SIC codes (6000–6999 for financial companies and 4900–4999 for utilities firms), (3) an acquirer is a public company, while a target might be either a public or private company, (4) total transaction value exceeds $1 mln.

Our requirements yield the sample of 492 US deals.

37% of the deals in our final sample were high-tech acquisitions where the targets are high-tech companies. Companies are considered high-tech according to the SIC (Standard Industrial Classification) codes that are presented in the Table 3 [25].

[2] The final model is chosen based on how well it explains the changes of the dependent variables, as well as the model's appropriateness in regard to Gauss-Markov's assumptions. For that reason, several tests on unbiasedness, multicollinearity, and homoscedasticity of the residuals were implemented.

Table 3. SIC codes for high-tech industry

High-tech industry	SIC Codes
Software	737
Medical technologies (incl. drugs)	283, 382, 873
Communications	366, 481, 489
Computer equipment	357
Electrical equipment	360 – 365, 367

In the resulting research sample, 316 of the transactions were domestic, and the remaining 176 were cross-border deals. It is interesting to note that of the 176 cross-border deals, twenty of the target companies are in emerging capital markets and the remaining 156 target companies are in developed countries. In regard to payment methods, it is worth noting that 305 deals are paid in cash, while the remaining 187 deals are paid in stock or a combination of stock and cash. As for deal size, the minimum deal amount is $1 million, and the maximum is $27 million.

Results

CEO clustering

Cluster analysis revealed a subsample of 165 companies with a common structure and similarity in CEO speeches during quarterly earnings calls/reports, independent of the companies' industry characteristics. The critical task is not to show that the overconfident tone is unrelated to industry characteristics, but to find the roots and factors that create this differentiation between the overall sample and the specific cluster of 165 companies. For this reason, a labor-intensive analysis was conducted to identify several possible combinations of factors that influence CEOs to behave similarly and, therefore, demonstrate similar behaviors during quarterly earnings calls. The analysis was conducted manually and includes a large number of combinations that could affect the tone of the CEO's speech. Several financial, non-financial, and personal characteristics of CEOs were analyzed, and a table of key differences between the entire sample and the subsample is presented in Table 4.

Table 4. Differentiation factors between clustered and the whole sample

Indicators that have different values for the whole sample and clustered sample	Average value for the whole sample	Average value for the cluster of 165 companies
Firm age as of one year before the M&A deal	63 years	72 years
Market capitalization as of one year before the M&A deal	$8703 mln	$7086 mln
Total assets value as of one year before the M&A deal	$7708 mln	$7900 mln
R&D expenses as of one year before the M&A deal	$163 mln	$119 mln
FCFF as of one year before the M&A deal	$384 mln	$285 mln
Number of transactions of the CEO in 2009–2019	16 deals per CEO	13 deals per CEO
Returns on assets as of one year before the M&A deal	4%	7%
Total debt to equity ratio as of one year before the M&A deal	74%	69%
CAR over a 10-day event window	0.005%*	0.003%*
Percentage of overconfident CEOs	86%	90%

*** – significant at 1% significance level, ** – significant at 5% significance level,

* – significant at 10% significance level.

The table represents the main differences between the clustered sample of 165 companies and the whole sample. The main differences between the two groups are the following: the clustered 165 companies are on average 9 years older, have an about $1,7 bln smaller market capitalization a year prior to the M&A deal, but have a higher total asset value. Moreover, they spend around $44 mln less on R&D expenses, as well as have around $100 mln less free cash flow in the year prior to the transaction. It seems that the whole sample's average indicators show that clustered companies are smaller in value and investments, but in regard to efficiency, it is essential to observe that they have a higher average return on assets and lower debt-to-equity ratio in the year preceding the deal, which indicates the higher efficiency of the clustered companies. It can be combined with the fact that clustered companies are older, thus, have more experience and optimized operations. Besides that, the percentage of overconfident CEOs is larger in the subsample of clustered companies, which directly affects the M&A performance indicator of CAR, too. It is observed that the average CAR for an 11-day event window is significantly lower for the subsample of 165 clustered companies, based on the t-test differences, which additionally proves the negative impact of CEO overconfidence on M&A outcomes. In addition to this fact, it can be argued that overconfident leaders use and structure their speeches in a similar way. To show this difference, an example of the earning calls of two companies from pharmaceutical industry is used. CVS Pharmaceuticals is selected from the clustered sample, while Vertex Pharmaceuticals is selected from the remaining part of the sample. The two companies from the same industry show the difference in their CEOs' behavior during quarterly earning calls. CVS' CEO concentrates mostly on the company's financial performance, i.e., in the following quote is from the transcript of the earnings call: "Today, we reported adjusted earnings per share from continuing operations of $0.65, which was at the high end of our expectation, and we generated $1.7 billion in free cash flow year-to-date, so we are well on track to meet our $2.5 billion targets for the year." As can be observed, at the beginning of the call CEO presents the company's financial indicators. A quote from the beginning of the call made by Vertex Pharmaceutical's CEO is as follows: "I'm pleased to say that our business is outperforming on multiple fronts. As we enter the second half of the year, we are on track to achieve or exceed our 2019 goals, and we're well-positioned for continued innovation and growth in the future." It can be seen that there are no exact indicators of the company's efficiency, but there is an emphasis on the company's goals and its positioning. The same pattern was observed when comparing other companies in the cluster sample of 165 companies and the rest of the sample. The above example shows that the executives of the clustered 165 companies try to focus more on quantitative metrics that show how they and their companies are performing, while the executives from the rest of the sample mostly emphasize qualitative analysis and company vision.

CEO overconfidence and CAR

The first step in our empirical analysis of the effects of CEO overconfidence on M&A results is devoted to M&A performance estimation using the event study analysis. Table 5 shows that stock market positively reacts to the announcements of M&A deals on the US market. CAARs for a 3-day and an 11-day event windows are positive and statistically significant at 5% and 10% level, respectively. It is important to note that these returns are quite low– slightly below 1% for all event windows, which is consistent with the results of previous researchers [26; 27].

Table 5. CARs for the full sample

Full sample of 492 deals				
Indicators	Min	Average	Max	P-value
CAR 3 (–1; +1)	–0.1890	**0.0073****	0.2368	0.0107
CAR 11 (–5; +5)	–0.2282	**0.0066***	0.2721	0.0903

*** – significant at 1% significance level, ** – significant at 5% significance level,

* – significant at 10% significance level.

The results of our regression analysis presented in Table 6 shows that CEO overconfidence has a negative effect on M&A performance and contributes to the destruction of the acquirer's value. So, the proposed Hypothesis 1 is not rejected at 1% level. This result is in line with the outcomes of the previous studies [3; 5].

Table 6. Impact of CEO overconfidence on M&A deal performance

Variables	CAR (–1; +1)	CAR (–5; +5)
CEO Overconfidence	–1.122***	–1.177***
Total revenue's 3-year CAGR	–0.001***	–0.001***
Education dummy	–0.004	0.007
Log (firm size)	0.000	–0.006**
Transaction-tenure difference	0.006	–0.001
CEO age	0.001	0.001*
GDP growth rate	–0.381	–0.461*
Constant	0.016	0.033
Number of observations	492	492
R^2	0.063	0.050
F-test	3.439	3.139

*** – significant at 1% significance level, ** – significant at 5% significance level,

* – significant at 10% significance level.

CEO overconfidence and CAR for high-tech companies

A separate analysis for a subsample of high-tech companies is performed on the same event windows as for the overall sample. The main question is to understand whether CEO overconfidence has a positive impact on M&A performance when a target is a high-tech company. First, CARs are calculated for the subsample of high-tech M&As. The results are presented in Table 7. As in the case of a general sample, we observe positive and significant stock market reaction to the announcements of such deals. The positive market reaction shows that in an innovative economy, the availability of high-tech production is critical for most corporations. The acquisition of technology through M&A enables such companies to gain a significant competitive advantage, which subsequently has a favorable effect on the market value of shares.

Table 7. CARs for high-tech M&As subsample

Sample of 187 high-tech companies				
Indicator	Min	Average	Max	P-value
CAR 3 (–1; +1)	–0.1652	0,0050**	0.2257	0.0291
CAR 11 (–5; +5)	–0.2173	0,001*	0.2102	0.0687

*** – significant at 1% significance level, ** – significant at 5% significance level,

* – significant at 10% significance level.

At the next step we build the regression analysis that shows the statistically insignificant impact of CEO overconfidence on the performance of M&A deals (Table 8). Thus, the proposed Hypothesis 2 is rejected. The logic may lie in the overall structure and goals of a company's acquisitions of high-tech firms. Many companies acquire technology firms to gain access to technology or research, know-how, market expertise or a highly skilled workforce. Therefore, the role of the acquiring company's CEO may not have an impact on the possible major gain from a particular M&A transaction.

Table 8. Impact of CEO overconfidence on M&A deal performance

Variables	CAR (–1; +1)	CAR (–5; +5)
CEO Overconfidence	0.532	–0.982
Transaction-tenure difference	0.0009	–0.001
CEO age	–0.0009	–0.001
Constant	0.058*	0.094*

Variables	CAR (–1; +1)	CAR (–5; +5)
Number of observations	187	187
R2	0.023	0.023
F-test	1.440	1.423

*** – significant at 1% significance level, ** – significant at 5% significance level,

* – significant at 10% significance level.

Conclusion

In recent decades, increased competition and the globalization of financial markets have led to an active growth in the volume and number of mergers and acquisitions (M&A). The high activity in the corporate control market has led to a growing academic interest in studying the performance and determinants of the performance of these transactions. According to a number of researchers and practitioners, one of the factors that determine the success of M&A deals is the overconfidence of the acquiring firm's CEO. In this article, we continue and expand the line of research on the impact of CEO overconfidence on M&A performance by (1) applying content analysis to measure CEO overconfidence, (2) analyzing the speeches of CEOs to reveal the factors that force them to structure their speeches in the same way, and (3) estimating the impact of CEO overconfidence on high-tech M&As, which are mostly positively assessed by stock markets.

Using event study and regression analysis, we found that CEO overconfidence has a significant negative impact on M&A performance, indicating that an overconfident CEO is more likely to believe that the market is mispricing the deal (as opposed to him), or is simply taking a risk, hoping that the situation will play out contrary to expectations. Further analysis showed that in high-tech M&As, the impact of CEO overconfidence on deal performance becomes insignificant.

As a result of the cluster analysis conducted to identify the factors that determine the general trends in CEO behavior during the earnings call, we identified a cluster of 165 companies with a common structure and similarity of CEO speeches that are not explained by the companies' affiliation with similar industries. This suggests that overconfident CEOs tend to use and structure their speeches similarly. The analysis of differences between the identified cluster and the remaining research sample showed that CEOs belonging to the cluster try to focus more on a company's quantitative indicators, while CEOs from the rest of the sample mainly focus on qualitative analysis and company vision. We also found differences in the financial characteristics of the companies belonging to the cluster of 165 companies and the rest of the sample. Another interesting result is that this cluster had a higher number of overconfident CEOs than the rest of the study sample, which contributes to a more restrained, statistically significant market reaction to M&A announcements.

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Appendix

Table A1. The Python script of overconfidence calculation

```
import glob
import re
import pandas as pd
```

```
df = pd.read_csv('words.csv', names = ['w', 's'])
df['w'] = df.w.map(lambda x:x.lower())
df.s.value_counts()
```

```
Negative        2355
Positive         354
Uncertaity       297
Weak modal        27
Strong Modal      19
Name: s, dtype: int64
```

```
negative = list(df.loc[df.s == 'Negative', 'w'])
positive = list(df.loc[df.s == 'Positive', 'w'])
uncert = list(df.loc[df.s == 'Uncertaity', 'w'])
weak = list(df.loc[df.s == 'Weak modal', 'w'])
strong = list(df.loc[df.s == 'Strong Modal', 'w'])
```

```
texts = glob.glob('text/*.txt')
```

```
general_coef = []
names = []
for doc in texts:
    with open(doc, encoding='cp1252') as file:
        data = file.read()
        data = data.replace('\n', ' ')
        data = ''.join(i for i in data if not i.isdigit())
        data = re.sub('[^A-Za-z0-9]+', ' ', data)
        data = data.lower()
        data = data.strip()
        data = data.split(' ')
    negative_c = 0
    positive_c = 0
    uncert_c = 0
    weak_c = 0
    strong_c = 0
    for i in data:
        if i in negative:
            negative_c +=1
        elif i in positive:
            positive_c += 1
        elif i in uncert:
            uncert_c += 1
        elif i in weak:
            weak_c += 1
        elif i in strong:
            strong_c += 1
    coef_ratio = ((positive_c+strong_c)-(negative_c+weak_c+uncert_c))/len(data)
    names.append(doc[5:])
    general_coef.append(coef_ratio)
```

```
dff = pd.DataFrame.from_dict({'company':names, 'value' : general_coef})
```

```
dff.to_excel('Martoun.xlsx', index = False)
```

Table A2. Summary statistics of variables for the whole sample

Variable	Obs	Mean	Std.Dev.	Min	Max
CAR	492	.004	.099	-.6	.44
Overconfidence	492	.01	.009	-.02	.05
Total revenue's 3-year CAGR	492	11.176	24.408	-89.785	308.018
Log (firm size)	492	7.579	1.672	3.776	12.127
CEO age	492	52.986	7.548	30	77
Education dummy	492	.413	.493	0	1
Transaction-tenure difference	492	8.715	6.998	0	40
GDP growth rate	492	.035	.014	-.031	.06

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