Nijmegen School of Management
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Master's Thesis Economics (MAN-MTHEC)

CEO Overconfidence and M&A Performance: Comparing Measures of Overconfidence

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Nijmegen, 28 June 2023

Program: Master's Program in Economics
Specialisation: Corporate Finance & Control
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Abstract

In this research the five-item CEO overconfidence proxy of Schrand & Zechman (2012) is compared with the option-based Longholder and Holder 67 CEO overconfidence proxies of Malmendier & Tate (2008) in an M&A context. This is done on a sample that attempts to replicate the sample of Malmendier & Tate (2008, 2015). The results indicate that the five-item overconfidence variable of Schrand & Zechman (2012) is not similar to the Longholder and Holder 67 variables of Malmendier & Tate (2008). The correlation coefficient is extremely low and the coefficient for the five-item overconfidence variable in an OLS regression with the Cumulative Abnormal Return of the acquiror's stock around an M&A deal announcement as dependent variable, differs significantly from those for the Longholder and Holder 67 variables. This leads to the conclusion that the five-item overconfidence variable of Schrand & Zechman (2012) should not be used to measure CEO overconfidence in the context of M&A and that the potential data availability and variable construction benefits of the proxy cannot be realized. Additional tests provisionally indicate that the five-item overconfidence variable produces different results as the Longholder and Holder 67 variables in other firm contexts as well.

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1 Introduction

Previous research has found that overconfidence in CEOs is an important factor that influences the success of a merger or acquisition (M&A). Overconfident CEOs are likely to overestimate their ability to create value in their own company and their ability to add value to another company by acquiring it. This leads them to overestimate merger synergies for their own company and overpay for a target much more often. Research finds that this generally leads to lower cumulative abnormal stock returns (CAR) for the acquiring company after the announcement of a merger or acquisition (Malmendier & Tate, 2008). This indicates the importance of M&A research on overconfidence, since it has important implications for real-world M&A deals. However, measuring CEO overconfidence in the context of economic research has been a topic of debate since day one.

The central problem with measuring overconfidence in economic research is that it is not unambiguous to measure a person's character traits using secondary data. However, there are some proxies that have proven to capture overconfidence quite well. The most common approach is either the Longholder or Holder 67 variable of Malmendier & Tate (2005, 2008), which uses option exercising behaviour of CEOs to approximate overconfidence. The same Malmendier & Tate (2008) also introduce a press-based measure for overconfidence, using the media's perception of a CEO to capture overconfidence. Despite their usefulness in capturing overconfidence in empirical economic research, these measures also have a few important limitations, especially with respect to the data availability and time to compute the variable.

The option-based proxies require extensive option holding and exercising information, which is only widely available for U.S. firm CEOs. The press-based proxy requires the researcher to collect media articles about a CEO, find key words that indicate overconfidence and manually check that these words indeed describe the CEO and not something else in the article. This proxy is thus very time-intensive and requires a lot of manual, boring work. What if there would be another proxy for overconfidence that relies on data that is available for most companies worldwide and is pretty straightforward to compute?

Such a proxy is introduced by Schrand & Zechman (2012), which is a proxy that consists of five financial statement figures related to investing and financing activities of the company. The fact

that the data comes from a company's financial statement means that it is available for all companies that publish a financial statement. Although this proxy for overconfidence has been used a couple of times after its introduction, to my knowledge it has not been compared with the more common overconfidence proxies. It is thus still unknown how the Schrand & Zechman (2012) proxy relates itself to the Malmendier & Tate (2008) proxies in the context of M&A research. This comparison is important, because it could indicate that future M&A research on the effect of overconfidence can either use a much broader available and less time-intensive proxy or should refrain from using this proxy because it does not measure the same as the Malmendier & Tate (2008) proxies.

Therefore, in this research the five-item overconfidence proxy of Schrand & Zechman (2012) will be compared with the option-based Longholder and Holder 67 proxies of Malmendier & Tate (2008). This will be done on the combined sample of Malmendier & Tate (2008) and Malmendier & Tate (2015). The first paper uses a sample from 1980 to 1994 and the second extends the first paper by using a more recent sample from 1996 to 2012. By combining these two samples, a large enough sample is created because not all deal data is still available, especially from the period before 1990. Ultimately, this creates a sample from 1986 to 2012, covering 340 deals by 235 large U.S. firms. With the effort to replicate the Malmendier & Tate (2008, 2015) sample it is possible to investigate whether the Schrand & Zechman (2012) overconfidence proxy provides similar results compared to the Longholder and Holder 67 proxies, when it is used to assess the impact of CEO overconfidence on M&A performance.

An inspection of the correlation coefficients of the three overconfidence variables shows that the Schrand & Zechman (2012) proxy is very weakly correlated to the Longholder and Holder 67 proxies. A Welch t-test on the mean Cumulative Abnormal Return (CAR) between overconfident and non-overconfident CEOs shows that there are important differences among the Schrand & Zechman (2012) and Longholder and Holder 67 variables as well. An OLS regression with CAR as dependent variable indicates that the coefficient for the Schrand & Zechman (2012) variable is significantly different from the coefficients of Longholder and Holder 67, which in turn is confirmed by a Z-test on the coefficients. This means that based on these results, the Schrand & Zechman (2012) variable cannot be used to measure CEO overconfidence in the context of M&A

research. Some additional tests seem to imply that the Schrand & Zechman (2012) variable might not be very useful in other contexts as well.

The rest of this paper is organized as follows. In Section 2 the most common overconfidence proxies are evaluated and the hypotheses are formulated. Section 3 describes the sample and main variables. Section 4 discusses the main findings and some additional tests. Section 5 provides a conclusion and discusses the limitations of the research.

2 Theoretical Framework

2.1 Option-based CEO Overconfidence

The research on the effect of CEO overconfidence on M&A performance uses a number of different proxies for CEO overconfidence. The most used proxies are based on CEOs stock option holdings in the company (Malmendier & Tate, 2008). CEOs often receive part of their compensation in the form of executive options. However, these options are mostly non-tradeable and the sale of the underlying stock is also restricted. CEOs are often not allowed to perfectly hedge their position by short-selling their firm's stock either, which means that they are underdiversified (Malmendier & Tate, 2005). A underdiversified and risk-averse CEO should exercise his/her options when they are sufficiently in-the-money towards maturity, because there is still the risk that the stock price falls in the remaining time to maturity. In that case, the CEO's payoff decreases and could even become zero, which means that the CEO's time and effort in the company are not rewarded in terms of financial compensation. A risk-averse CEO will thus always choose to take the profit instead of waiting to exercise the option at the risk of a lower (or zero) payoff. However, an overconfident CEO believes to be able to push up the stock price (and thus the option value) further and will thus wait until maturity with exercising the option. The Longholder proxy for CEO overconfidence uses this intuition, by classifying CEOs as overconfident when they hold an option that is 40% in-the-money at the beginning of the final year to maturity, at least once during their employment. Another proxy that uses CEOs' stock option holdings is the Holder 67 variable, which classifies CEOs as overconfident when they hold an option with five years remaining duration despite a 67% increase in the underlying stock price since the grant date (Malmendier & Tate, 2008). This means that CEOs don't necessarily have to hold their significantly in-the-money options until expiration to be considered overconfident, but at least hold them until they are fully vested (which is in most cases five years before expiration).

One of the shortcomings of these option-based CEO overconfidence measures is that they capture inaction, but it is impossible to determine when the decision to not do something is made (Ismail & Mavis, 2022). This makes it hard to establish a link between non-exercise and strategic decisions, because the decision by a CEO to not exercise could also be made to reassure investors

of his/her commitment to the company. Secondly, once a CEO is considered a Longholder or Holder 67, he/she is considered to be overconfident for the rest of the sample period. However, CEOs don't necessarily have to display the same option-exercising behavior over time. A person's (over)confidence can change over time as well.

Finally, the lack of data, as acknowledged by Malmendier & Tate (2008) themselves as well, is a downside of the option-based measures. For U.S. companies, data on executive option holdings is available in the Execucomp database for example, which includes detailed information on grant dates, exercise prices and option values. However, for European companies this data is not readily available. Researchers rely on BoardEx (which provides less detailed option-based compensation data) or hand-collected data from firm's annual reports. Besides, there is great variety between countries in how option-based compensation is reported in a firm's annual report (Kotnik & Sakinç, 2022). This makes it hard to gather data on CEOs' option holdings for European firms.

2.2 Press-coverage CEO Overconfidence

Another often-used measure for CEO overconfidence, also introduced by Malmendier & Tate (2008), is a so-called press coverage proxy. This measure requires the researcher to gather articles about CEOs in large business journals and it classifies a CEO as overconfident when the number of articles describing the CEO as "optimistic" or "confident" is larger than the number of articles describing the CEO as "cautious", "conservative" or "steady" for example. Whereas the option-based measures are market-based, this measure is based on the perception of the CEO's beliefs by outsiders.

However, this measure also has its flaws. The main problem, as recognized by Malmendier & Tate (2008) as well, is that the measure is necessarily noisy and that it is less accurate compared to the option-based measures. This is caused by the fact that the measure relies on perceptions by others, which means that it might lack objectivity and is based on the perception of the author, which could be very different from the perception of the general public. Another problem is the endogeneity issue (Malmendier & Tate, 2008). It is very well possible that mergers change the sentiment of the media on that CEO. An acquiring CEO could be perceived as more confident or an acquiring CEO could try to create positivism around his/her company during a merger process.

Finally, as to some extent also recognized by Ismail & Mavis (2022), the press-coverage measure is very time-intensive and might suffer from a selection bias. Constructing this measure takes a lot of time, because all articles that are found on the company or CEO using the words "optimistic", "confident", etc. have to be hand-checked to make sure that these terms describe the CEO (and not something else in the article). Besides, the limited information availability using this measure might create a selection bias. Business articles are often written when there is 'news' about the company or CEO, which means that companies or CEOs that are not considered 'newsworthy' by the media are underrepresented in the sample.

2.3 Other CEO Overconfidence measures

A few other CEO overconfidence measures that are less frequently used include Net Buyer, Relative Compensation and Recent Organizational Performance. The Net Buyer measure is introduced by Malmendier & Tate (2005) and is a market-based proxy. It relies on a similar intuition as the option-based measures, namely that a CEO that owns stocks of his own company is exposed to the company risk (because diversification is not allowed). A CEO is considered overconfident using the Net Buyer measure when he/she is a net buyer of company stock during the first five sample years. This means that a CEO bought shares on net in more years than he/she sold on net. Such a CEO can be considered overconfident because he/she thus increases his/her already high exposure to company risk by buying more stock on net. However, this measure might just as well capture a CEO's expectation about future stock performance or a CEO's risk appetite instead of the CEO's (over)confidence (Ismail & Mavis, 2022).

The Relative Compensation measure builds on the believe of the CEO to have superior abilities compared to other executives, which should be rewarded with a much higher compensation. It is calculated as the cash compensation of the CEO divided by the cash compensation of the second-highest paid employee (Hayward & Hambrick, 1997). However, compensation could be a measure for a lot of other factors as well, which makes it not a very accurate measure.

The Recent Organizational Performance proxy is also explained in Hayward & Hambrick (1997). This measure relies on research that has found that leaders are highly credited for the success of the company, even when there are other factors that the success could be objectively attributed

to. This in turn increases the CEO's confidence and creates higher expectations of his/her own abilities. The measure thus predicts CEOs to be overconfident when the recent performance of their company is high. However, the recent performance of a company will probably also have a direct effect on M&A performance (since the market's reaction of a deal depends on the performance of the acquiror as well), which means that it is not an unbiased measure of CEO overconfidence in the M&A context.

2.4 The five-item Overconfidence measure

Measuring character traits of CEOs is obviously very hard if you rely on publicly available data. Understanding a person's character is very difficult if you don't know that person or haven't seen/heard a lot about him/her. That explains why all the discussed CEO overconfidence measures come with significant internal validity issues. However, the problems with respect to data availability or data gathering time might be easier to resolve.

Schrand & Zechman (2012) propose another measure for overconfidence. This is a proxy that requires financial statement data, which makes it available for European companies as well and is less time-intensive to construct. It can thus potentially mitigate the data availability/gathering issues of the option-based and press-coverage measures. This measure consists of five items that capture a firm's investing and financing activities that are related to overconfidence. The five items are (1) industry-adjusted net dollars of acquisitions made by the firm, (2) industry-adjusted debt to equity ratio, (3) convertible debt or preferred stock, (4) dividend yield, and (5) industry-adjusted excess investment. A more detailed description of each of these five items is given in Section 3.2. One characteristic different from most other overconfidence proxies is that this five-item proxy can vary much more over time. Since the values depend on financial statement data that change every year, the values for the overconfidence proxy can vary by year as well. This is different to the Longholder and Holder 67 proxies for example, where a CEO is considered overconfident for the rest of his/her tenure once the specific option-exercising conditions are met. If this five-item proxy captures CEO overconfidence in the context of M&A performance just as well as the widely used option-based proxies, future research would be able to investigate the

effect of CEO overconfidence for a much broader sample than just U.S. firms and spend less time on variable construction.

However, it is important to point out some flaws of this measure beforehand as well. One major drawback is that this proxy is very indirect, because it uses firm level data to explain a single individual's character trait. The CEO is obviously assumed to have a big influence on these firm outcomes, but it is not likely that there is a one-on-one relation between the CEO's actions and firm outcomes. However, that is what this proxy implicitly assumes. Another flaw of the proxy is that it makes the assumption that a CEO's character traits might change year on year. It is likely that a non-overconfident CEO becomes overconfident at a point in time or vice versa, but it is unlikely that this shift happens every year. However, that is theoretically possible when this proxy is used. To allow for some variation over time in a CEO's character traits is desirable, but not on such a frequent basis.

2.5 Hypotheses

Overconfident CEOs are likely to overestimate their ability to create value in their own company and their ability to add value to another company by acquiring it. This leads them to overestimate merger synergies for their own company and overpay for a target much more often. That is why the literature on CEO overconfidence and M&A performance generally predicts a negative relation between CEO overconfidence and merger performance, especially for the acquiror (Malmendier & Tate, 2008). That means that the five-item overconfidence variable by Schrand & Zechman (2012) should also predict a negative effect when it is used in the context of M&A performance.

The first step is to determine the similarity of the five-item measure with the two option-based measures in general. Therefore, the following hypothesis will be tested by constructing the correlation coefficients between the three variables:

H1: The five-item overconfidence variable introduced by Schrand & Zechman (2012) correlates strongly with the Longholder and Holder 67 variable of Malmendier & Tate (2008).

Secondly, the similarity of the five-item measure with the two option-based measures in the context of M&A performance has to be investigated. This leads to the following hypothesis that will be tested using an OLS regression model:

H2: Overconfident CEOs do mergers that perform worse than mergers done by non-overconfident CEOs when using the five-item overconfidence variable, to a similar extent as found with the Longholder and Holder 67 variables by Malmendier & Tate (2008).

3 Methodology

3.1 Sample

The data sample consists of 340 M&A deals done by 234 acquirors between 1986 and 2012. This sample results from an effort to combine the sample of Malmendier & Tate (2008) and Malmendier & Tate (2015). The first paper uses a sample from 1980 to 1994 and the second extends the first paper by using a more recent sample from 1996 to 2012. By combining these two samples, a large enough sample is created because not all deal data is still available, especially from the period before 1990. Ultimately, this creates the sample as described above.

The companies included in the sample are the largest U.S. companies based on revenue. As discussed above, the sample is a replication of the Malmendier & Tate (2008, 2015) sample. The firms included in their sample have to be in the Forbes 500 list of largest U.S. companies at least four times during the sample period. Since it is not possible to use the Forbes 500 list as search criterium in Refinitiv Workspace, a threshold of $500 million revenue is applied, since this is the lower bound to be included in the Forbes 500 list of largest U.S. companies at the start of the sample period. Firms that report $500 million revenue or more in all sample years are included in the sample.

With the effort to replicate the Malmendier & Tate (2008, 2015) sample it is possible to investigate whether the Schrand & Zechman (2012) overconfidence proxy provides similar results compared to the Longholder and Holder 67 proxies, when it is used to assess the impact of CEO overconfidence on M&A performance.

Data on M&A deals and acquiror's stock price returns come from Refinitiv Workspace. The accounting data used to construct the five-item overconfidence measure also comes from the Refinitiv Workspace database. This data is supplemented with CEO stock and option holdings from the Execucomp and BoardEx databases. This data is used to construct the Longholder and Holder 67 variables and the Stock Ownership and Vested Options control variables. The data on Relatedness and Cash Financing comes from Refinitiv Workspace again.

Provided below in Table 1 are descriptive statistics of the main variables. What strikes most is that the average CAR in Table 1 is 0.2%, whereas Malmendier & Tate (2008) find an average CAR

of -0.3%. However, as can be seen in Table 5 further on, this does not influence the results of the replication much, since the results that the samples produce are similar.

Table 1
Descriptive statistics

Statistic	N	Mean	Median	St. Dev.	Min	Max
CAR	340	0.002	0.002	0.07	-0.68	0.47
Overconfidence	340	0.07	0	0.26	0	1
Longholder	340	0.12	0	0.33	0	1
Holder 67	340	0.07	0	0.26	0	1
Relatedness	340	0.74	1	0.44	0	1
Cash Financing	340	0.24	0	0.43	0	1
Stock Ownership	340	0.67	0.70	0.18	0.001	1.12
Vested Options	340	0.05	0.00	0.29	0.00	2.73

CAR is the Cumulative Abnormal Return of the acquiror's stock in an event window from one day before until one day after the merger announcement using the S&P 500 return as benchmark for expected returns. Overconfidence is a binary variable based on the five-item measure of CEO overconfidence by Schrand & Zechman (2012), with a value of 1 indicating overconfidence. Longholder is a binary variable based on Malmendier & Tate (2008), indicating CEO overconfidence with a value of 1. Holder 67 is another binary variable indicating CEO overconfidence with a value of 1 (Malmendier & Tate, 2008). Relatedness is a binary variable that displays a value of 1 when the target and acquiror are in the same industry based on the Refinitiv Macro Industry classification. Cash Financing is a binary variable that has a value of 1 if the deal is completely financed with a combination of cash and debt. Stock Ownership is the value of the stocks owned by the CEO at the beginning of the merger announcement year as a fraction of common shares outstanding of the company. Vested options is the value of fully vested/exercisable options held by the CEO at the beginning of the merger announcement year as a fraction of common shares outstanding. Because of a lack of data, missings for Stock Ownership and Vested Options are interpolated, replacing the missings for these variables with their mean value.

3.2 Variables

The dependent variable in the OLS regression of Table 4 is merger performance. This is measured by the stock market reaction to the merger announcement. In line with Malmendier & Tate (2008), the cumulative abnormal return (CAR) from one day before to one day after the announcement is calculated. The S&P 500 index daily return is used as a measure of expected return, since all firms in the sample are U.S. firms.

The main independent variable is CEO overconfidence. This will be measured by using a proxy of five items as introduced by Schrand & Zechman (2012) and applied by Khlifi & Zouari (2021), Kouaib & Jarboui (2016) and Sutrisno & Karmudiandri (2020). The five items are (1) industry-adjusted net dollars of acquisitions made by the firm, (2) industry-adjusted debt to equity ratio, (3) convertible debt or preferred stock, (4) dividend yield, and (5) industry-adjusted excess investment. This measure takes on the value 1 if the sum of the five items is equal to or greater than three and 0 otherwise.

The (1) industry-adjusted net dollars of acquisitions takes on the value of 1 if the net acquisitions on a firm's cash flow statement are larger than the industry-median and 0 otherwise. Malmendier & Tate (2008) namely find that overconfident CEOs are both more likely to overpay for an acquisition and engage in a value destroying acquisition. The (2) industry-adjusted debt to equity ratio takes on the value of 1 if the long term debt divided by the firm's market value is above the industry median and 0 otherwise. Hackbarth (2008) finds that overconfident managers overestimate their firm's ability to repay its liabilities and thus choose higher levels of debt and issue new debt more often. The third component, (3) convertible debt or preferred stock, takes on the value of 1 if a firm uses either convertible debt or preferred equity and 0 otherwise. Ben-David et al. (2008) show that overconfident executives have longer debt duration, which is a measure of risky debt. Overconfident managers thus choose risky debt more often. The (4) dividend yield component takes on the value of 1 if the firm does not pay out dividends (dividend yield of zero) and 0 otherwise. Ben-David et al. (2008) provide evidence that overconfident managers payout lower cash dividends to save internal cash for investment opportunities. The final component, the (5) industry-adjusted excess investment, is the residual of a regression of a firm's total asset growth divided by sales growth on investments (Khlifi & Zouari, 2021). The dependent variable is the net increase of tangible and intangible fixed assets as a fraction of total assets. The independent variable is the change in assets from the previous year divided by the change in sales from the previous year[1]. A positive residual indicates that a firm makes investments at a higher rate than expected based on sales growth. A residual greater than zero means that this component takes on the value of 1 and 0 otherwise. Ben-David et al. (2008) predict that overconfident CEOs overestimate the payoffs of investments and underestimate the risk of the payoffs, leading to excess investments.

A CEO is classified as overconfident when at least three of the five components return a value of 1 (so when at least three out of five components indicate overconfidence).

The second variable to measure CEO overconfidence, with which the five-item variable will be compared, is the Longholder variable from Malmendier & Tate (2008). This binary variable takes

[1] $Invest_{it} = \beta_0 + \frac{Asset\ growth\ rate_{it}}{Sales\ growth\ rate_{it}} + \varepsilon_{it}$

on the value 1 if a CEO during his/her employment holds an option of the company until maturity, even though it was at least 40% in-the-money at the beginning of the last year of maturity. If this is not the case, the variable has a value of 0. The reasoning behind this is that a rational (non-overconfident CEO) will exercise the option when it is significantly in-the-money at the start of its final year, because the CEO's compensation is determined by the option value. However, an overconfident CEO overestimates his/her ability to increase the stock price within a year and thus overestimates his/her ability to increase the value of the option. If a CEO is considered a Longholder once, he/she will remain for the rest of the sample period.

The third CEO overconfidence measure is the Holder 67 variable (Malmendier & Tate, 2008). This variable considers option-exercising behavior of CEOs five years before the option expires. If the CEO failed to exercise an option with a remaining duration of five years despite a 67% increase in the underlying stock price since the grant date, this variable takes on the value of 1 and the CEO is considered overconfident. If this is not the case, the variable takes on the value of 0. If a CEO is considered a Holder 67 once, he/she will remain for the rest of the sample period.

4 Main Results

4.1 Correlations

The first test to compare the Overconfidence variable with the Longholder and Holder 67 variable is by investigating the correlation coefficients. Table 2 shows the correlation matrix of the three CEO overconfidence measures. As expected, the Longholder and Holder 67 variables correlate positively with each other (0.664). In line with Berg et al. (2022), a correlation coefficient of 0.7 or higher is considered a strong correlation when comparing variables that measure the same effect. This means that the Longholder and Holder 67 variable are highly correlated, but just not enough to conclude a strong correlation. However, the Overconfidence variable is positively related to the Longholder and Holder 67 variables, but is very weakly correlated to these variables. In both cases the correlation coefficient by far doesn't even exceed 0.1. We can conclude from Table 2 that the Overconfidence variable is positively, but extremely weakly, related to the Longholder and Holder 67 variables. This means that the first hypothesis formulated in Section 2.5 cannot be accepted.

Table 2
Correlation matrix of CEO overconfidence measures

	Overconfidence	Longholder	Holder 67
Overconfidence	1		
Longholder	0.001	1	
Holder 67	0.014	0.664	1

Overconfidence is a binary variable based on the five-item measure of CEO overconfidence by Schrand & Zechman (2012), with a value of 1 indicating overconfidence. Longholder is a binary variable based on Malmendier & Tate (2008), indicating CEO overconfidence with a value of 1. Holder 67 is another binary variable indicating CEO overconfidence with a value of 1 (Malmendier & Tate, 2008).

Secondly, the three overconfidence variables are compared based on their prediction for the difference in average CAR for mergers done by non-overconfident CEOs and mergers done by overconfident CEOs, as seen in Table 3. The results in Table 3 are generated using a Welch t-test, since the variances between the overconfident and non-overconfident groups are unequal for all three overconfidence variables, according to an F-test on variances.

What strikes most is that for all three variables there is no significant difference in average CAR between the two sets of merger deals, since all p-values are above 0.05. However, with the

Longholder and Holder 67 variables, the average CAR for overconfident CEOs is negative (-0.29% and -1.36% respectively) whereas the average CAR for non-overconfident CEOs is positive (0.29% and 0.34% respectively). When using the Overconfidence variable, it turns out that overconfident CEOs have even higher CARs compared to non-overconfident CEOs (2.09% and 0.08% respectively). This is completely opposing the results using the Longholder and Holder 67 variables. Based on Table 3, the Overconfidence variable is not a substitute for the Longholder or Holder 67 variable, since it produces opposing results. However, this conclusion has to be made with caution, since the results are not significant.

Table 3
Welch t-test on the differences in mean CAR for overconfident and non-overconfident CEOs per overconfidence measure.

CAR	Non-Overconfident	Overconfident	P-value
Overconfidence	0.00080	0.02090	0.362
Longholder	0.00294	-0.00290	0.546
Holder 67	0.00342	-0.0136	0.154

CAR is the Cumulative Abnormal Return of the acquiror's stock in an event window from one day before until one day after the merger announcement using the S&P 500 return as benchmark for expected returns. Overconfidence is a binary variable based on the five-item measure of CEO overconfidence by Schrand & Zechman (2012), with a value of 1 indicating overconfidence. Longholder is a binary variable based on Malmendier & Tate (2008), indicating CEO overconfidence with a value of 1. Holder 67 is another binary variable indicating CEO overconfidence with a value of 1 (Malmendier & Tate, 2008). Note: *p**p***p<0.01

4.2 Regression results

In Table 4 the results of three OLS regressions are displayed with the CAR as dependent variable and the five item CEO Overconfidence variable, the Longholder variable and the Holder 67 variable as independent variables among a few control variables. The equation that will be tested is displayed below.

$$CAR_i = \beta_0 + \beta_1 Overconfidence_i + \beta_2 Longholder_i + \beta_3 Holder67_i + \beta_4 Relatedness_i + \beta_5 Cash\ financing_i + \beta_6 Stock\ ownership_i + \beta_7 Vested\ options_i + \varepsilon_i \quad (1)$$

The control variables that will be used are frequently used in related research (Malmendier & Tate, 2008) and are standard predictors of the stock market's response to a merger announcement. The control variables are Relatedness, Cash Financing, Stock Ownership and Vested Options. Relatedness is a binary variable that takes on the value of 1 if the acquiror and target are in the same industry based on the Refinitiv Macro Industry classification and 0

otherwise. Cash financing includes bids that are financed completely with a combination of cash and debt (these are given a value of 1, 0 otherwise). Stock ownership is the number of stocks of the company that the CEO holds at the start of the year in which the merger bid takes place as a fraction of common shares outstanding. Vested options are the holding of options on the company stock by the CEO that are exercisable within six months before the start of the merger bid year as a fraction of common shares outstanding. Finally, year fixed effects are used to control for time effects, since mergers take place in different years across the sample period.

Since the sample is a replication of the sample used by Malmendier & Tate (2008, 2015), it is first of all important to check how well the replication turned out. This is done in Table 5.

In Table 6 of Malmendier & Tate (2008) a similar regression is run as in Table 4 of this research. When comparing model (3) of the Malmendier & Tate (2008) table with model (2) in Table 4, the most important variable of interest, the Longholder variable, has almost the same coefficient in both models and is significant in both, as can be seen in Table 5 below. The Holder 67 variable is not included in a regression with the CAR as dependent variable in the Malmendier & Tate (2008) paper, so it is not possible to compare the coefficient of Holder 67. However, since it is also negative and significant in Table 4 (-0.023), it can be assumed that the replication is done good enough, since the sign and strength of the coefficient are very similar to the Longholder coefficient that Malmendier & Tate (2008) find. The R-squared of the models is also very similar, once more indicating that they are very comparable. Some small differences however are found with the control variables. Cash Financing is positive but not significant in Table 4, but the size of the coefficient is very comparable to the one that Malmendier & Tate (2008) found (0.009 and 0.0155 respectively). Stock ownership has a negative coefficient instead of a positive one, but is insignificant in both models. Vested Options has a positive coefficients in both models, but is only significant in the model of Malmendier & Tate (2008). Besides, the size of the effect differs substantially as well (0.001 versus 0.1071).

Looking at the main variable of interest, the Longholder variable, and the R-squared of the overall models, the replication of the sample used by Malmendier & Tate (2008, 2015) has been done well.

Table 4
OLS regression results

	Dependent variable:		
	CAR		
	OLS		
	(1)	(2)	(3)
Overconfidence	0.003		
	(0.009)		
Longholder		-0.013*	
		(0.007)	
Holder 67			-0.023**
			(0.010)
Relatedness	0.004	0.004	0.004
	(0.005)	(0.005)	(0.005)
Cash Financing	0.009	0.009	0.009
	(0.006)	(0.006)	(0.006)
Stock Ownership	-0.002	-0.001	0.0001
	(0.013)	(0.013)	(0.013)
Vested Options	-0.002	0.001	0.004
	(0.008)	(0.008)	(0.008)
Constant	-0.009	-0.009	-0.010
	(0.017)	(0.017)	(0.017)
Year Fixed Effects	Yes	Yes	Yes
Observations	330	330	330
R^2	0.108	0.116	0.124
Adjusted R^2	0.018	0.028	0.037

The dependent variable, CAR, is the Cumulative Abnormal Return of the acquiror's stock in an event window from one day before until one day after the merger announcement using the S&P 500 return as benchmark for expected returns. Overconfidence is a binary variable based on the five-item measure of CEO overconfidence by Schrand & Zechman (2012), with a value of 1 indicating overconfidence. Longholder is a binary variable based on Malmendier & Tate (2008), indicating CEO overconfidence with a value of 1. Holder 67 is another binary variable indicating CEO overconfidence with a value of 1 (Malmendier & Tate, 2008). Relatedness is a binary variable that displays a value of 1 when the target and acquiror are in the same industry based on the Refinitiv Macro Industry classification. Cash Financing is a binary variable that has a value of 1 if the deal is completely financed with a combination of cash and debt. Stock Ownership is the value of the stocks owned by the CEO at the beginning of the merger announcement year as a fraction of common shares outstanding of the company. Vested options is the value of fully vested/exercisable options held by the CEO at the beginning of the merger announcement year as a fraction of common shares outstanding. Because of a lack of data, missings for Stock Ownership and Vested Options are interpolated, replacing the missings for these variables with their mean value. Based on DFFIT values, 10 observations are removed from the regression since they should be considered influential outliers, leaving 330 deals. Standard errors are presented in parentheses below the coefficients. Note: *p**p***p<0.01

Table 5
Comparing coefficients in Table 4 with coefficients in Malmendier & Tate (2008) Table 6

	Table 4	M&T (2008) Table 6
Longholder	-0.013*	-0.0155***
Relatedness	0.004	0.0034
Cash Financing	0.009	0.0155***
Stock Ownership	-0.001	0.0561
Vested Options	0.001	0.1071***
Observations	330	789
R^2	0.116	0.08

Longholder is a binary variable based on Malmendier & Tate (2008), indicating CEO overconfidence with a value of 1. Relatedness is a binary variable that displays a value of 1 when the target and acquiror are in the same industry based on the Refinitiv Macro Industry classification. Cash Financing is a binary variable that has a value of 1 if the deal is completely financed with a combination of cash and debt. Stock Ownership is the value of the stocks owned by the CEO at the beginning of the merger announcement year as a fraction of common shares outstanding of the company. Vested options is the value of fully vested/exercisable options held by the CEO at the beginning of the merger announcement year as a fraction of common shares outstanding. Because of a lack of data, missings for Stock Ownership and Vested Options are interpolated, replacing the missings for these variables with their mean value. Note: *p**p***p<0.01

To my knowledge, there is not yet a published article that uses the five-item overconfidence measure of Schrand & Zechman (2012) in a regression with the acquiror's CAR of a merger transaction as dependent variable. Schrand & Zechman (2012) themselves investigate a M&A context, but use real earnings management as their dependent variable. It is therefore not possible to compare the coefficient for Overconfidence in Table 4 with a coefficient in a different study. This would have been a nice additional test to verify a correct construction of the variable.

After inspecting how well the sample of Malmendier & Tate (2008) is replicated based on the regression results, it is possible to discuss the results of Table 4. The most important result is the fact that the coefficient for Overconfidence is positive and insignificant (0.003), whereas the coefficients for Longholder and Holder 67 are both negative and significant (-0.013 and -0.023 respectively). The Overconfidence variable predicts that the cumulative abnormal return of an acquiror's stock increases with 0.3% when the merger is performed by an overconfident CEO (compared to when it would be performed by a non-overconfident CEO). The Longholder and Holder 67 variable predict a drop in cumulative abnormal return of the acquiror's stock of 1.3% and 2.3% respectively when the merger is performed by an overconfident CEO.

To conclude about similarity of results, a Z-test on the difference between the coefficients for the three different overconfidence variables in model (1), (2) and (3) of Table 4 is performed, with

p-values of this test displayed in Table 6. This shows that the coefficient for the Overconfidence variable is significantly different from the coefficients of Longholder and Holder 67 at the 10% and 5% level respectively. It also shows that the Longholder and Holder 67 coefficients are not significantly different from each other, as expected judging from visual inspection. Table 6 confirms that the Overconfidence variable predicts a significantly different effect for CEO overconfidence on merger performance than the Longholder and Holder 67 variable. We can state that the effect of overconfidence on M&A performance measured with the five-item Overconfidence variable of Schrand & Zechman (2012) does not lead to similar results when measured with the Longholder or Holder 67 variables of Malmendier & Tate (2008), since the coefficients are significantly different from each other. This strongly indicates that the five-item Overconfidence variable should not be used to capture CEO overconfidence in the context of M&A performance. This leads us to conclude that the second hypothesis formulated in Section 2.5 cannot be accepted.

Table 6
P-values of the Z-test on the difference in coefficients from Table 4 for the three overconfidence variables

P-values	Overconfidence	Longholder
Longholder	0.0803*	
Holder 67	0.0266**	0.7937

Overconfidence is a binary variable based on the five-item measure of CEO overconfidence by Schrand & Zechman (2012), with a value of 1 indicating overconfidence. Longholder is a binary variable based on Malmendier & Tate (2008), indicating CEO overconfidence with a value of 1. Holder 67 is another binary variable indicating CEO overconfidence with a value of 1 (Malmendier & Tate, 2008). The p-values are based on the coefficients and related standard errors in parentheses in Table 4. For Overconfidence the coefficient is 0.003 (0.009), for Longholder -0.013 (0.007) and for Holder 67 -0.023 (0.010). The Z-score on the difference in coefficients is calculated as follows: $Z = \frac{\beta_1 - \beta_2}{\sqrt{(SE\beta_1)^2 + (SE\beta_2)^2}}$, with β_1 and β_2 being the coefficients from Table 4 of the two overconfidence variables for which the specific Z-score is calculated. This equation is provided by Clogg et al. (1995). Note: *p**p***p<0.01

4.3 Additional tests

The above analyses indicate that the Overconfidence variable by Schrand & Zechman (2012) does not capture the same effect as the Longholder and Holder 67 variables by Malmendier & Tate (2008) in the context of an M&A study. However, Ismail & Mavis (2022) show that it could be useful to test an overconfidence variable in different firm contexts as well. To get an indication of how the five-item Overconfidence variable compares to the other two option-based overconfidence variables, four panel data regressions will be run over the sample period 1986 to 2012, using 217 U.S. firms. The merger deals sample consists of 235 firms, but some of these firms

drop out in this panel data set, because there is not enough data available over the entire sample period. The five-item overconfidence measure of Schrand & Zechman (2012) and the Longholder and Holder 67 variables of Malmendier & Tate (2008) are used as the main independent variables and four firm proxies are used as dependent variable in separate fixed effects regressions. The five-item Overconfidence variable is based on financial statement data and can thus change value every year, since the underlying numbers also change every year. The Longholder and Holder 67 however assume that once a CEO meets the requirements with regards to option-exercising behavior to be qualified as overconfident, this CEO is overconfident for the entire sample period. This means that these variables behave differently in a panel data set.

The four dependent variables are Capital Expenditures, Leverage, Equity Issues and Innovation, as initiated by Ismail & Mavis (2022). Capital Expenditures are a firm's capital expenditures scaled by the book value of total assets. The Leverage is the book value of debt over the book value of total assets of the firm. Equity Issues is calculated as the sale of common and preferred shares minus the purchase of common and preferred shares divided by the book value of total assets. Innovation is measured as the R&D expenses of the company as a fraction of total assets, in line with Hirshleifer et al. (2012).

To control for firm-specific characteristics some control variables are added, in line with Ismail & Mavis (2022). The logarithmic book value of assets controls for firm size. The market-to-book ratio is the share price multiplied by the number of outstanding shares divided by the book value of shareholders equity. The third control variable is the book value of debt over the book value of assets (this will not be used as a control variable in the regression with the leverage ratio as dependent variable, since this is the leverage ratio). The final control variable is the ratio of operating cash flows to total assets. The regression equation is displayed below.

$$CapEx_{it} = \beta_0 + \beta_1 Overconfidence_{it} + \beta_2 Assets_{it} + \beta_3 MarketBook_{it} + \beta_4 Leverage_{it} + \beta_5 OperatingCF_{it} + \varepsilon_i \quad (2)$$

The results are presented in Table 7a and 7b. What strikes most is that the coefficient for the five-item Overconfidence variable is only similar to one of the other two overconfidence variables in the model with Leverage as dependent variable (model 4, 5 and 6). There, the Overconfidence and Longholder coefficients are both positive and significant. In all the other models, the

Overconfidence coefficient is either significant when the other two are not or insignificant when the other two are significant.

This indicates that the five-item Overconfidence variable of Schrand & Zechman (2012) captures CEO overconfidence not very well in other contexts either. In the case of leverage the coefficients are relatively similar, but for other firm contexts the coefficients are very different. One thing that has to be pointed out is that the R-squared of the models is relatively low, below 0.1 in nine of the twelve models. This means that the predictive power of these models in general is quite low, so the conclusions from them have to be made with some caution. However, it leads to the provisional conclusion that the five-item overconfidence variable of Schrand & Zechman (2012) should not be used in different contexts either.

Table 7a
Panel data regression of overconfidence on two of four different dependent variables

	Dependent variable:					
	Capital Expenditures			Leverage		
	Fixed Effects			*Fixed Effects*		
	(1)	(2)	(3)	(4)	(5)	(6)
Overconfidence	0.011***			0.024***		
	(0.002)			(0.006)		
Longholder		-0.005			0.105***	
		(0.003)			(0.011)	
Holder 67			0.004			-0.005
			(0.005)			(0.017)
Total Assets	-0.007***	-0.007***	-0.007***	0.064***	0.060***	0.064***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Market-to-book ratio	0.00003	0.00003	0.00003	-0.0001	-0.0001	-0.0001
	(0.00003)	(0.00003)	(0.00003)	(0.0001)	(0.0001)	(0.0001)
Debt-to-assets ratio	-0.027***	-0.025***	-0.026***			
	(0.004)	(0.004)	(0.004)			
Operating CF to assets	0.012*	0.012*	0.012*	-0.141***	-0.133***	-0.143***
	(0.006)	(0.006)	(0.006)	(0.023)	(0.023)	(0.023)
Year and company FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,943	4,943	4,943	4,943	4,943	4,943
R^2	0.075	0.067	0.067	0.196	0.207	0.193
Adjusted R^2	0.032	0.024	0.023	0.158	0.171	0.156

The results are found on a panel dataset of 217 U.S. firms for the period 1986-2012. The dependent variable in model (1), (2) and (3) is Capital Expenditures. This represents a firm's capital expenditures scaled by the book value of total assets. The dependent variable in model (4), (5) and (6) is Leverage, which is the book value of total liabilities divided by the book value of total assets. Overconfidence is a binary variable based on the five-item measure of CEO overconfidence by Schrand & Zechman (2012), with a value of 1 indicating overconfidence. Total assets is the logarithm of the book value of total assets in a certain year for a specific firm. The market-to-book ratio is the market value of the company divided by the book value of shareholders equity. The debt-to-assets ratio is the book value of total liabilities divided by the book value of total assets. Operating cash flow to assets represents the cash flow from operating activities divided by the book value of total assets. All regressions include controls for year and firm fixed effects. Standard errors are presented in parentheses below the coefficients. Note: *p**p***p<0.01

Table 7b
Panel data regression of overconfidence on two of four different dependent variables

	Dependent variable:					
	Equity Issues			Innovation		
	Fixed Effects			*Fixed Effects*		
	(7)	(8)	(9)	(10)	(11)	(12)
Overconfidence	-0.002			0.018**		
	(0.005)			(0.007)		
Longholder		0.020**			-0.011	
		(0.008)			(0.014)	
Holder 67			0.025**			0.0005
			(0.013)			(0.020)
Total Assets	-0.024***	-0.024***	-0.024***	-0.0003	-0.0002	-0.0005
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Market-to-book ratio	0.0001	0.0001	0.0001	-0.0003***	-0.0003***	-0.0003***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Debt-to-assets ratio	-0.024***	-0.028***	-0.024***	0.021	0.025	0.023
	(0.011)	(0.011)	(0.011)	(0.017)	(0.017)	(0.017)
Operating CF to assets	-0.156***	-0.155***	-0.155***	-0.282***	-0.283***	-0.283***
	(0.017)	(0.017)	(0.017)	(0.027)	(0.027)	(0.027)
Year and company FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,943	4,943	4,943	5,013	5,013	5,013
R^2	0.090	0.091	0.091	0.024	0.023	0.023
Adjusted R^2	0.048	0.049	0.049	-0.021	-0.022	-0.022

The results are found on a panel dataset of 217 U.S. firms for the period 1986-2012. The dependent variable in model (1), (2) and (3) is Equity Issues, which is the sale of common and preferred stock minus the purchase of common and preferred stock, divided by book value of total assets. The dependent variable in model (4), (5) and (6) is Innovation, which is the R&D expense as a fraction of the book value of total assets. Overconfidence is a binary variable based on the five-item measure of CEO overconfidence by Schrand & Zechman (2012), with a value of 1 indicating overconfidence. Total assets is the logarithm of the book value of total assets in a certain year for a specific firm. The market-to-book ratio is the market value of the company divided by the book value of shareholders equity. The debt-to-assets ratio is the book value of total liabilities divided by the book value of total assets. Operating cash flow to assets represents the cash flow from operating activities divided by the book value of total assets. All regressions include controls for year and firm fixed effects. Standard errors are presented in parentheses below the coefficients. Note: *p**p***p<0.01

5 Conclusion

The aim of this research is to conclude whether the five-item overconfidence variable introduced by Schrand & Zechman (2012) is similar to the Longholder and Holder 67 variables of Malmendier & Tate (2008) in the context of M&A research. If this is the case, this could help future research to extent the research on the effect of CEO overconfidence to a sample with not only U.S. firms and save a lot of time on variable construction and data gathering. The results of this research indicate that the five-item overconfidence variable of Schrand & Zechman (2012) is not similar to the Longholder and Holder 67 variables of Malmendier & Tate (2008). The correlation coefficient is extremely low and the coefficient for the five-item overconfidence variable in the OLS regression differs significantly from those for the Longholder and Holder 67 variables. This leads to the conclusion that the five-item overconfidence variable of Schrand & Zechman (2012) should not be used to measure CEO overconfidence in the context of M&A. Additional tests aim to give some provisional insights into the usefulness of the five-item overconfidence variable in different contexts. This tentatively indicates that the Schrand & Zechman (2012) CEO overconfidence variable is not useful in other firm contexts either.

Future research could investigate the usefulness of the five-item overconfidence measure in these and other contexts in more detail. It would also be very interesting for future research to compare the other research papers that use the five-item overconfidence variable with the Longholder or Holder 67 variables, to assess the size of the measurement problem and potential impact on their results. Khlifi & Zouari (2021) and Kouaib & Jarboui (2016) for example use the variable in an earnings management context. It would be interesting to test if the five-item overconfidence variable is comparable with the option-based variables in that context or that the results of their research are biased.

It is important to point out some limitations of this research. First of all, the replication of the Malmendier & Tate (2008, 2015) sample is not perfect, mainly because it uses older data that is no longer fully available. The analysis of the replication indicates that the differences are not problematic, but they might influence the results. Another limitation is the fact that it is not possible to compare the five-item overconfidence variable of Schrand & Zechman (2012) constructed in this research with the one constructed in their research. This is due to the fact that

the data sample is completely different and the focus of the research is different, which means that other variables are used. Although Schrand & Zechman (2012) explain quite in depth how their variable is constructed (and it was thus possible to try and do that with the data used in this research), it would have been useful to be able to compare the variable in this research with theirs, since the conclusions of this research depend very much on a good construction of the Schrand & Zechman (2012) variable.

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7 Appendix

7.1 Data inspection

First of all, to test for heteroscedasticity a Breusch-Pagan test is performed. The p-value is 0.1443, which means that the null hypothesis is not rejected and that there is no heteroscedasticity in the data.

A Durbin-Watson test is performed to check the regression model for autocorrelation. Since the p-value of the test is 0, we can't reject the null hypothesis and have to assume that there is autocorrelation in the data. This means that the residuals are not independent.

The Shapiro-Wilk test shows that, with a p-value of 0.0016, the data on Cumulative Abnormal Returns are not normally distributed. However, this test knows some limitations of which one is that it becomes sensitive to small deviations with larger sample sizes. It is therefore important to use a visual test as well. The visual representation can be found in Figure 1. This shows that the distribution is close to normal since the line approaches a 45-degree line. It is therefore assumed that the data on CAR is normally distributed.

Figure 1
Normal Q-Q plot of data on Cumulative Abnormal Returns