Restraining Overconfident CEOs through Improved Governance: Evidence from the Sarbanes-Oxley Act

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The literature posits that some CEO overconfidence benefits shareholders, though high levels may not. We argue that adequate controls and independent viewpoints provided by an independent board mitigates the costs of CEO overconfidence. We use the concurrent passage of the Sarbanes-Oxley Act and changes to the NYSE/NASDAQ listing rules (collectively, SOX) as natural experiments, to examine whether board independence improves decision making by overconfident CEOs. The results are strongly supportive: after SOX, overconfident CEOs reduce investment and risk exposure, increase dividends, improve postacquisition performance, and have better operating performance and market value. Importantly, these changes are absent for overconfident-CEO firms that were compliant prior to SOX. (*JEL* G23, G32, G34)

Overconfidence can lead managers to overestimate returns and underestimate risk. The literature suggests that even though some CEO overconfidence

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can benefit shareholders, a highly distorted view of risk-return profiles can destroy shareholder value. An intriguing question is whether there are ways to channel the drive and optimism of highly overconfident CEOs while curbing the extremes of risk taking and overinvestment associated with such overconfidence. We explore such a possibility in this paper. Specifically, we investigate whether appropriate restraints on CEO discretion and the introduction of diverse viewpoints on the board serve to moderate the actions of overconfident CEOs and thus benefit shareholders.

Although governance issues, such as board independence, have been viewed mainly through the lens of managerial agency, they have a bearing in the context of CEO overconfidence, as well. For instance, even though the scandals that precipitated Sarbanes-Oxley Act of 2002 (SOX) and the changes to NYSE/NASDAQ listing rules[1] are usually attributed to poor governance and unethical behavior, they were likely exacerbated in many cases by managerial hubris. In the case of Enron, for instance, it is claimed that overconfidence may have rendered managers slow to recognize their mistakes and quick to engage in risky behavior in their attempt to cover up these mistakes (O'Connor 2003). These troubles were likely compounded by a permissive board that exhibited groupthink and inadequate oversight. SOX and the changes to the NYSE/NASDAQ listing rules were intended to mitigate such problems by, *inter alia*, increasing independent oversight in both the board and the audit committee. This package of reforms, combining increased board and audit-committee independence, represents a significant strengthening in oversight (Clark 2005). The increased oversight, and the diverse set of viewpoints, promoted by an independent board, could help to attenuate the effect of managerial moral hazard and biased beliefs.

Although the consequences of SOX and the listing rules have been studied in the context of poorly governed firms, the question for us is whether the increased oversight and other governance changes also helped to reign in the more harmful aspects of CEO overconfidence. Evidence that SOX improved the decision making of overconfident CEOs would demonstrate that appropriate governance structures and advice can help to channel better the optimism of overconfident managers toward creating shareholder value.

The double-edged nature of confidence is evident from the literature. Confidence is essential for success in myriad domains, including business (Puri and Robinson 2007). Not surprisingly, CEOs tend to be more optimistic, and less risk-averse, than the lay population is (see e.g, Graham, Harvey, and Puri 2013). Overconfidence can be a desirable trait in managers when, for instance, there are valuable, but risky, investments to be made in developing new technologies or

[1] For brevity, unless otherwise stated, because these changes were concurrent, we refer to the set of changes in SOX and to the listing rules as "SOX" unless otherwise stated (per Guo, Lach, and Mobbs 2015; Linck, Netter, and Yang 2009). Indeed, the changes implemented in SOX precipitated the NYSE/NASDAQ changes, and it is the combination of increased independence in both the board (through a majority independent board) and in the audit committee that improved oversight (Clark 2005).

products (see, e.g., Hirshleifer, Low, and Teoh 2012; Galasso and Simcoe 2011; Simsek, Heavy, and Veiga 2010). The downside is that overconfidence can lead to faulty assessments of investment value and risk, resulting in suboptimal decision making.

We use the concurrent passage of the Sarbanes-Oxley (SOX) Act of 2002 and the changes to the NYSE/NASDAQ listing rules as a natural experiment to investigate whether governance changes can moderate the effect of CEO overconfidence. In some ways these changes provide an ideal setting for such a test: they were exogenous to the circumstances of specific firms, but were associated with improvements in governance, disclosure, and monitoring (see e.g., Coates 2007), which we briefly discuss in Section 1 By requiring a fully independent audit committee and a majority of directors to be independent, SOX, coupled with the NYSE/NASDAQ rule changes, is believed to have helped bring new perspectives and greater scrutiny into the board room. Consequently, we would expect SOX to mitigate the extent to which overconfident CEOs could hold sway over insider-dominated boards.

A concern with using SOX as an instrument is that it was enacted during a single year and it is, therefore, possible that firm policies and values were influenced by other events at the time. We address this concern in various ways. An important falsification test is to scrutinize the changes in firms with overconfident CEOs that were not effected by the passage of SOX and the rule changes, because they were already compliant with its key requirements (i.e., by having a majority of independent directors and a fully independent audit committee prior to 2002). Further confidence is gained by a variety of specific tests such as the performance of subsequent Mergers and Acquisitions (M&A) activity that is not easily explained other than by changes in the nature of decision making of firms with overconfident CEOs. Our regressions include a large number of firms and CEO control variables, in addition to firm and year fixed effects.

We use both options-based and press-based measures of overconfidence. The premise behind the option-based measures is that a CEO's human capital and personal wealth is tied to his or her company. Because CEOs are relatively undiversified, they should exercise rationally deep-in-the-money options and cash out the shares as and when they vest. Thus, holding deep in-the-money vested options represents a degree of overconfidence.[2] We construct overconfidence measures similar to those in Malmendier and Tate (2005), Malmendier and Tate (2008), and Malmendier et al. (2011). We use a continuous measure of CEO overconfidence and an indicator that equals one if the CEO's options measure is in the top quartile of the sample. In robustness tests, we examine other measures of overconfidence, including press-based measures of overconfidence.

[2] As confirmed in Malmendier and Tate (2008), the return from holding these options is poor, inconsistent with an inside-information explanation for not cashing out.

We have several important findings. We first examine the investment choices by overconfident CEOs. Our results indicate that, prior to SOX, overconfident CEOs invest more aggressively than their peers do. However, after the passage of SOX, overconfident CEOs appear to moderate their capital expenditures, bringing them more in line with the CEOs of otherwise comparable firms in their industries. For example, before SOX, the average capital expenditure/asset (henceforth, CAPEX/Assets) for our entire sample was about 5.8%, whereas the average for firms run by overconfident CEOs was about 6.7%. After SOX, firms with overconfident CEOs reduced CAPEX/Assets significantly to around 6.02%. SOX is also associated with a reduction in asset growth and property plant and equipment (PP&E) growth. The pattern is similar for sales, general and administrative expenses (SG&A). In this, we follow the argument in Chen, Gores, and Nasev (2013) that overconfident CEOs are less likely to adjust SG&A downward, reflecting their inflated beliefs about future growth prospects and SG&A needs. Focusing on the firms that were not compliant with SOX before its passage, for the median firm, SOX led to a 52% reduction in CAPEX, and a 39.7% reduction in PP&E, as compared with the firms that were compliant with SOX's provisions prior to its passage.

SOX also affects the sensitivity of investment to cash flows of overconfident managers. As Malmendier and Tate (2005) show, overconfident CEOs spend more of their cash flows on capital expenditures, reflecting their greater propensity to invest available internal funds. We find that, post-SOX, overconfident CEOs' investment sensitivity to cash flow decreases. In addition, post-SOX, firms with overconfident CEOs exhibit a significant drop in risk, both systematic and firm specific.

An important question is whether the reduction in investment and risk taking works to the benefit of shareholders. In other words, does SOX curb the value-destroying tendencies of overconfident CEOs or does it, instead, hinder value creation by these CEOs and force them to abandon positive-NPV projects? For our tests, we use several measures of firm performance. We use both market-based and accounting-based measures of firm performance, namely Tobin's Q, earnings before interest and tax (EBIT), and S&P's earning quality (EQ) measure. We also examine the effect of overconfidence on the value of research and development (R&D) and CAPEX. Our results are unambiguous–along with the reduction in investment expenditure and risk, overconfident CEOs create more shareholder value post-SOX. For example, relative to other CEOs, overconfident CEOs are associated with a 0.043 point lower Tobin's Q prior to SOX and a 0.026 point larger Q afterward, representing an increase of 0.069 in Tobin's Q. Similarly, when we focus on the firms that were not compliant with SOX prior to its passage, we find that, for the median firm, SOX improved the effect of CEO overconfidence on Q by around 13.87% relative to the firms that were compliant.

Next we examine the performance of overconfident CEOs in the context of acquisitions. Malmendier and Tate (2008) find that overconfident CEOs

tend to undertake acquisitions that create significantly less shareholder wealth. After the passage of SOX, however, takeovers by overconfident CEOs create relatively greater amount of long-term shareholder wealth (or equivalently, destroy less shareholder wealth). Another issue is that of dividend payout. With the drop in investment expenditure of overconfident CEOs, firms would have more free cash flow available to distribute in the form of dividend payout. We find that although payout tends to be low for overconfident firms (see e.g., Deshmukh, Goel, and Howe 2013), there is a significant increase in payout, after SOX. Although it is difficult to disentangle the effect of SOX from that of the (nearly) contemporaneous dividend tax cut, when coupled with the reduction in expenditures, SOX appears to encourage overconfident CEOs to distribute cash to shareholders.

We conduct a number of robustness tests to increase our confidence in the results and their interpretation. As noted above, we conduct falsification tests to show that, for the most part, these SOX-related changes are concentrated in the companies that were *not* previously compliant with SOX (in relation to the need for an independent audit committee and a majority-independent board). Specifically, by using both difference-in-difference-type tests, and subsample tests, we find that the effect of SOX on overconfident CEOs concentrates in those firms that were previously noncompliant with SOX's mandates.[3] In addition, the SOX-related effects observed for overconfident managers are not present for CEOs with confidence in the bottom quartile. Together, these falsification tests suggest that our results reflect the effect of SOX in moderating the implications of CEO overconfidence.

We undertake several additional robustness tests to mitigate econometric issues. As noted, we control for various firm, CEO, and governance characteristics, and include firm or industry and year fixed effects. Given that our results relate to a strong exogenous event (SOX), and we support these results with the aforementioned falsification tests, endogeneity (reverse causality) is unlikely to drive our results. Nonetheless, we conduct some additional robustness tests to mitigate reverse-causality concerns. We confirm that overconfidence tends to be "sticky" over time (as Malmendier and Tate 2005 have previously shown) suggesting that it is a stable behavioral characteristic rather than a function of contemporaneous firm performance. We also conduct robustness tests using alternative measures of CEO overconfidence: it is shown that results hold when using a press-based measure of overconfidence; a *Holder67* measure of overconfidence; and a measure based on the value of the CEO's vested-but-unexercised options scaled by his/her salary.

[3] For many of our tests, we compare compliant firms with firms that are highly noncompliant. We define a firm as "highly noncompliant" if it was both noncompliant with SOX and it was an above-median distance from having a majority independent board.

Our results contribute to the literatures on managerial overconfidence and market regulation. We confirm that CEO overconfidence can lead to excessive risk taking and expenditure. The results provide (some) support for exogenously mandated improvements in certain governance practices. Although it might be more of an unintended consequence, SOX appears to have been beneficial in terms of mitigating significant value destruction and in capitalizing on the positive aspects of CEO overconfidence. Thus, the paper provides novel evidence on the benefits of SOX: these benefits go beyond limiting expropriation and perquisite consumption by powerful CEOs and are important in terms of moderating the excesses of highly overconfident CEOs. Although there may be questions as to whether our findings extrapolate to other types of broad governance changes that may have been proposed or enacted, in the specific case of SOX appears to have acted as a beneficial restraint on CEO excesses and thus increased shareholder wealth (and social welfare).[4]

Our results connect with prior work in the context of overconfidence and governance. Our findings also support evidence in Campbell and others (2014) that overconfident CEOs are more likely to be dismissed than are other CEOs in boards dominated by outsiders, highlighting the centrality of improved governance to mitigating the effect of CEO overconfidence. Our results also connect with the finding in Kolasinski and Li (2013) that a majority independent board can reduce the acquisitiveness of overconfident CEOs. Our findings differ from, and extend, those in Kolasinski and Li (2013) in that we analyze the value implications of such improved governance, assess myriad aspects of corporate behavior (i.e., CAPEX, firm value, operating performance, the value of investments, and the value implications of takeovers), and provide additional evidence on the efficacy of SOX in the specific context of CEO overconfidence.

1. Hypotheses

Overconfident CEOs, by definition, are overly optimistic about their investments and opportunities. They are more likely to undertake hubristic takeovers (see e.g., Roll 1986; Hayward and Hambrick 1997) and to spend more resources internally (i.e., in CAPEX or asset growth Malmendier and Tate 2008). Overconfident CEOs also engage in increased personal and corporate risk taking (see, e.g., Cain and McKeon 2013). The argument is that because overconfident CEOs overestimate the expected value of their investments and underestimate the downside risk, they are more likely to increase corporate risk than are other CEOs.

SOX is ostensibly intended to restrict managerial excesses, increase transparency, and improve corporate governance (for a complete summary, see

[4] Such evidence is consistent with prior literature that suggests that SOX prevents insiders from expropriating from minority shareholders, and is associated with improvements in disclosure and governance (see e.g., Arping and Sautner 2013).

Coates 2007). These include having an independent audit committee (Section 301), executive certification of financial reports (Section 302), disclosure of managerial assessment of internal controls (Section 404), and a code of ethics for senior financial officers (Section 406). SOX also prevents accounting firms from providing both auditing and nonauditing services to the same firm and increased penalties for corporate fraud. Put together, the increased environment of disclosure and monitoring by a more independent board can help to moderate managerial excesses. It is an empirical question as to whether such constraints can restrain CEO overconfidence and enhance shareholder wealth.

There is evidence suggesting that SOX might impose significant costs on some companies (see e.g., Iliev 2010; Leuz, Triantis, and Yue Wang 2008). However, despite the potential costs, there is evidence that SOX enables better protection for minority shareholders against extraction of value by insiders, improvements in disclosure and governance (see e.g., Arping and Sautner 2013), and increases in market value (see e.g., Switzer 2007). Overall, the literature suggests that SOX is generally associated with better governance and disclosure. Given that overconfident CEOs might be expected to overinvest and to assume more risk than is optimal from a shareholder's perspective, and may be less likely to learn from past mistakes when doing so (Chen, Crossland, and Luo 2014), we hypothesize that stronger governance may curtail these excesses. This is all the more so in light of prior evidence that overconfident CEOs are more likely to be dismissed than are other CEOs in boards dominated by outsiders as shown in Campbell, Gallmeyer, Johnson, Rutherford, and Stanley (2011). The above discussion gives rise to the following hypotheses:

Hypothesis 1. SOX reduces the effect of CEO overconfidence on corporate investment.

Hypothesis 2. SOX weakens the effect of CEO overconfidence on firms' exposure to systematic and unsystematic risk.

Malmendier and Tate (2005) have argued that overconfident managers tend to be more cash constrained, given their high investment levels and their reluctance to raise external equity capital. Thus, if there is a decrease in the capital expenditure in these firms, we would also expect a decrease in their investment-to-cashflow sensitivity. This is tested along with other tests on the effect of SOX on investment policies of firms with overconfident CEOs.

Hypothesis 3. SOX weakens the investment-cash-flow sensitivity of overconfident CEOs.

To the extent that SOX reduces excessive risk taking and wasteful expenditures by overconfident CEOs, we expect there to be a positive effect

on their firms' operating performance and on other measures of firm valuation. We predict, therefore, the following

Hypothesis 4. SOX enhances the effect of CEO overconfidence on firm value.

Hypothesis 5. SOX enhances the effect of CEO overconfidence on operating performance.

Given that we expect SOX to curb the wasteful expenditure and excessive risk taking tendencies of overconfident CEOs, it follows that SOX can help to increase the value of the R&D and CAPEX investments that they do make.

Hypothesis 6. SOX enhances the value of CAPEX and the value of R&D investment in firms managed by overconfident CEOs.

The effect of SOX in moderating CEO overconfidence should encourage better takeover decisions. Managerial overconfidence can induce over bidding and value destruction in acquisitions (see e.g., Kolasinski and Li 2013; Malmendier and Tate 2008). Additionally, poor corporate governance appears to facilitate such acquisitions. For example, entrenched CEOs appear to make acquisitions that destroy more corporate value (see, e.g., Masulis, Wang, and Xie 2007; Harford, Humphery-Jenner, and Powell 2012). We might, therefore, expect SOX to help reduce over bidding in acquisitions and encourage CEOs to engage in greater long-term value creation. Kolasinski and Li (2013) provide some consistent evidence, suggesting that a strong independent board reduces the likelihood that an overconfident manager undertakes an acquisition. From an empirical standpoint, we are most interested in long-term value creation (as compared with short-run market returns) given the evidence that the market can take some time to impound the value implications of takeovers (see e.g., Schijven and Hitt 2012). This leads to the following prediction:

Hypothesis 7. SOX improves the effect of CEO overconfidence on long-term value creation in acquisitions.

In addition, Malmendier, Tate, and Yan (2011) argue that overconfident CEOs consider their firms under valued and, hence, prefer not to raise external equity financing. They choose to retain earnings to finance investments and therefore pay lower dividends (see e.g., Deshmukh, Goel, and Howe 2013). We anticipate that, to the extent SOX curbs overinvestment and other wasteful expenditures, it would free more cash for companies to pay as dividends. We therefore predict the following:

Hypothesis 8. SOX encourages overconfident CEOs to increase dividend payments.

2. Data

This study utilizes several standard data sets. Our data on CEO compensation are from the Execucomp Database. We start with approximately 30,000 observations on CEO compensation between January 1, 1992 and December 31, 2012. After excluding observations with missing data on essential components of CEO compensation, we obtain a sample size of approximately 22,000 firm-year observations for which we can compute the "CEO confidence" measure. When creating this sample, we exclude cases where the data are insufficient to construct our option-based measure of overconfidence. Next we merge these modified Execucomp data with the Compustat and CRSP databases to obtain the firm-level variables and the variables on market return required for our analysis. We also obtain additional data on the percentage holdings of all institutional investors from the Thomson 13f filing database. The acquisition data set is from SDC. In robustness tests, we use data from IRRC/Risk Metrics to examine the effect of antitakeover provisions.

We construct a continuous "CEO confidence" variable. The CEO confidence measure is based on the CEO's option holdings. The logic is that CEO's human capital is undiversified, and the CEO ordinarily has a large part of their wealth tied to the company. Thus, a rational CEO would exercise options as and when they vest. Therefore, holding vested in-the-money options represents a degree of overconfidence (see e.g., Malmendier and Tate 2005).[5]

We use Execucomp data to construct the overconfidence measure. We first obtain the total value per option of the in-the-money options by dividing the value of all unexercised exercisable options (Execucomp item: opt unex exer est val) by the number of options (Execucomp item: opt unex exer num). Next we scale this value per option by the price at the end of the fiscal year as reported in (Compustat item named: prcc f). This gives an indication of the extent to which the CEO retains in-the-money options that are vested. This is analogous to the variables in Malmendier and Tate (2008). The variables differ slightly from those in Malmendier and Tate (2008) because the Execucomp database does not provide the same set of variables as their proprietary database. In our main tests, we allow the overconfidence measure to vary over time because of prior evidence that overconfidence can vary over time based upon past experience and performance (see e.g., Billett and Qian 2008; Hilary and Menzly 2006). Further, we create an indicator variable that equals one if the CEO's confidence measure is in the top quartile of all firms in that year.[6]

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[5] Malmendier and Tate (2005, 2008) highlight that holding such in-the-money options is indeed a behavioral bias, and they find no evidence that such options holdings connote private information. Further, although it is arguable that CEOs that choose to hold such options are simply well incentivized, and thus should perform better, such an interpretation is inconsistent with the finding both in this paper and in prior work (Malmendier and Tate 2005, 2008), that option-based measures of overconfidence are negatively associated with corporate performance.

[6] We examine a continuous variable, in addition to the indicator variable, because of prior evidence (in Ben-David Graham and Harvey 2013) that many executives miscalibrate the risk/return distribution, suggesting that there is a continuum of miscalibration and overconfidence.

In robustness tests, we ensure that the results are robust to various different definitions of overconfidence, including newspaper or press-based measures of overconfidence. As per Hirshleifer, Low, and Teoh (2012), we hand collect data on how the press portrays each of the CEOs from 2000–2006. We search for articles referring to the CEOs in The New York Times (NYT), Business Week (BW), Financial Times (FT), The Economist, Forbes Magazine, Fortune Magazine, and The Wall Street Journal. For each CEO and sample year, we record the number of articles containing the words *over confident or over confidence, optimistic or optimism, reliable, cautious, conservative, practical, frugal, or steady*. We carefully check that these terms are generally used to describe the CEO in question and separate out newspaper articles describing the CEO of interest as not confident or not optimistic. We then construct the variable "Net News," which is equal to the number of "confident" references less the number of "not confident" references. This alternative proxy of CEO over confidence is significantly positively correlated with our option-based financial measures.

We also use the Execucomp database to obtain other governance variables that might influence corporate performance, including CEO tenure, CEO age, the ratio of bonus compensation to fixed salary, and the CEO's percentage ownership.

The acquisition data-set starts with all acquisition announcements in SDC, which we then merge with accounting data (from Compustat), managerial overconfidence data (from Execucomp) and institutional ownership data (from the Thomson 13f filings). To construct this data set, we identify the acquirer in an acquisition. We then obtain the relevant explanatory variables for the acquiring company, including a set of control variables that are standard in the acquisition literature.

We use the firm-year panel to estimate the effect of SOX and overconfidence on firm value, expenditure (i.e., CAPEX and asset growth), corporate risk (beta, daily stock-return variance, and mean squared error), and, further, the effect on the value of cash holdings, CAPEX, and R&D. In all models we control for time fixed effects to mitigate issues of unobserved time effects that could otherwise bias an examination of SOX. When examining the firm-year panel of observations, we examine models that include industry and year effects, as well as those that include firm and year fixed effects. In the acquisition sample, we use industry and year effects. In robustness tests we also examine the effect of SOX on companies that were already SOX complaint to further ensure that the reported results are attributable to the governance changes imposed by SOX.

We report the sample composition by year in Table 1 and provide summary statistics in Table 2. The statistics in Table 1 indicate that overconfidence is relatively stable over time. This is consistent with the idea that CEO overconfidence is a behavioral trait (rather than a transient reflection of the corporation's position). The summary statistics in Table 2 provide some indication of the nature of our sample. Panel A presents the statistics for the panel

Table 1
Sample composition by year

		Confidence(t)					
Year	Obs.	Mean	Median	25th percentile	75th percentile	Std dev	Δ Confidence
1992	198	0.329	0.301	0.153	0.459	0.241	
1993	633	0.348	0.325	0.137	0.525	0.258	0.019
1994	910	0.311	0.274	0.086	0.478	0.259	−0.037
1995	944	0.337	0.319	0.126	0.499	0.252	0.026
1996	998	0.356	0.337	0.132	0.550	0.258	0.019
1997	1,049	0.411	0.418	0.200	0.601	0.278	0.055
1998	1,090	0.365	0.364	0.105	0.584	0.283	−0.046
1999	1,148	0.348	0.292	0.039	0.587	0.316	−0.017
2000	1,190	0.355	0.319	0.043	0.582	0.370	0.008
2001	1,246	0.304	0.251	0.063	0.488	0.276	−0.051
2002	1,374	0.220	0.151	0.004	0.368	0.232	−0.084
2003	1,436	0.322	0.291	0.103	0.487	0.271	0.102
2004	1,513	0.357	0.343	0.156	0.526	0.249	0.035
2005	1,492	0.355	0.330	0.122	0.534	0.287	−0.002
2006	1,510	0.380	0.364	0.165	0.554	0.268	0.025
2007	1,597	0.337	0.300	0.082	0.537	0.298	−0.043
2008	1,546	0.165	0.047	0.000	0.280	0.223	−0.172
2009	1,525	0.201	0.121	0.000	0.338	0.226	0.036
2010	1,468	0.257	0.202	0.050	0.409	0.242	0.056
2011	1,253	0.244	0.179	0.032	0.407	0.242	−0.013

This table contains the sample composition by year. Variable definitions are in the appendix. Figures are sample averages. We define Δ Confidence = Mean Confidence(t) - Mean Confidence(t-1).

data sample, and Panel B presents statistics for the M&A sample. The figures in Panel B are broadly consistent with those reported in prior literature. In particular, acquirer CARs are close to zero for CAR(-10, 10) or slightly negative for BHAR(-42, 125), which is consistent with prior literature (see e.g., Masulis, Wang, and Xie 2007; Harford, Humphery-Jenner, and Powell 2012; Moeller, Schlingemann, and Stulz 2004). The mean level of managerial confidence for the acquirers (0.38) is higher than that for the general sample (0.31), which is consistent with prior evidence that managers who are more confident tend to undertake more acquisitions (see e.g., Malmendier and Tate 2008). The following sections use these data to conduct a multivariate analysis of effect of SOX on the effect of managerial overconfidence.

3. SOX & Overconfidence: Investment Policy, and Corporate Risk

3.1 Does SOX restrain overinvestment by overconfident CEOs?

We begin by testing our first hypothesis using a difference-in-difference approach. In particular, we test whether changes in the firm's investment, asset growth, and sensitivity of investment to cash flows following the passage of SOX are related to the CEO's overconfidence in the manner predicted by our hypotheses.

3.1.1 Capital expenditure following SOX. Our hypothesis is that the passage of SOX results in overconfident CEOs becoming less aggressive in terms of capital expenditures. We test the relationship between the passage of SOX,

Table 2
Summary statistics

Variable	Mean	Median	25th percentile	75th percentile	Std dev
Panel A: Statistics for the panel data sample					
Confidence	0.309	0.268	0.062	0.496	0.277
Beta	1.244	1.157	0.799	1.576	0.654
MSE	0.024	0.021	0.015	0.030	0.013
Variance	0.100	0.058	0.031	0.116	0.142
Tobin's Q	1.324	0.935	0.509	1.649	1.299
Ind adj Tobin's Q	−0.034	−0.195	−0.624	0.240	1.127
EBIT/assets	0.085	0.085	0.042	0.133	0.095
Ind adj EBIT/assets	−0.001	−0.001	−0.036	0.040	0.088
Assets	8702	1593	528	5389	24983
PPE/assets	0.535	0.444	0.220	0.782	0.400
LT debt/ assets	0.192	0.170	0.038	0.299	0.168
R&D / assets	0.042	0.000	0.000	0.033	0.100
Intangibles/assets	0.154	0.086	0.011	0.244	0.176
CAPEX/sales	0.076	0.038	0.020	0.076	0.124
Cash/ assets	0.093	0.050	0.016	0.131	0.109
Dividends/ assets	0.010	0.002	0.000	0.015	0.016
SG&A/ sales	0.252	0.216	0.119	0.339	0.177
Bonus/salary	0.726	0.359	0.000	1.002	1.163
CEO tenure	6.726	5.000	2.000	9.000	7.167
CEO age (years)	55.379	55.000	51.000	60.000	7.225
CEO-ownership	0.020	0.003	0.001	0.012	0.048
Inst.-ownership	0.575	0.654	0.399	0.813	0.319
Panel B: Statistics for the M&A sample					
CAR(-10,10)	0.002	0.003	−0.055	0.064	0.111
BHAR(-42,125)	−0.106	−0.054	−0.314	0.166	0.471
BHAR(-5,125)	−0.080	−0.040	−0.255	0.144	0.385
Confidence	0.383	0.364	0.148	0.575	0.274
SOX	0.681	1.000	0.000	1.000	0.466
Diversifying deal	0.439	0.000	0.000	1.000	0.496
Run up	0.003	0.015	−0.326	0.312	0.668
Compted deal	0.014	0.000	0.000	0.000	0.119
Tender offer	0.058	0.000	0.000	0.000	0.233
Public target	0.195	0.000	0.000	0.000	0.396
Cash only	0.400	0.000	0.000	1.000	0.490
Rel deal size	0.136	0.039	0.011	0.130	0.262
ln(transaction value)	4.519	4.430	3.246	5.690	1.756
ln(assets)	7.792	7.613	6.558	8.945	1.705
Tobin's Q	1.666	1.202	0.749	2.046	1.504
EBIT/assets	0.102	0.098	0.060	0.144	0.080
Intangibles/assets	0.208	0.162	0.041	0.334	0.188
LT debt/ assets	0.178	0.155	0.035	0.276	0.157
R&D/sales	0.052	0.011	0.000	0.065	0.091
Cash/assets	0.099	0.059	0.020	0.137	0.108
CAPEX/sales	0.072	0.038	0.022	0.068	0.119
CEO bonus/salary	0.995	0.657	0.000	1.307	1.392
ln(CEO tenure)	1.742	1.792	1.099	2.303	0.816
ln(CEO age)	3.993	4.007	3.912	4.094	0.132
CEO-ownership	0.016	0.003	0.001	0.011	0.040
Inst-ownership	0.668	0.706	0.559	0.828	0.239

Table 2 shows the summary statistics of all the variables. We depict sample averages, median, 25th and 75th percentiles, and standard deviations of all of our variables of interest and our control variables. These are averages over all years between 1992 and 2011.

CEO-confidence, and CAPEX using a regression model of the following form:

$$\text{CAPEX/Assets}_{i,t+1} = \alpha + \text{SOX}_{i,t}\beta^{(1)} + \text{Confidence}_{i,t}\beta^{(2)} + \text{SOX}_{i,t} \times \text{Confidence}_{i,t}\beta^{(3)} + \mathbf{X}_{i,t}\theta + \lambda_{j(i)} + \phi_t + \varepsilon_{i,t}, \quad (1)$$

where, $\mathbf{X}$ represents a set of CEO and firm-control variables, and ϕ_t, and $\lambda_{j(i)}$ are year, and industry (firm) dummies, respectively. SOX is an indicator that equals one if the observation occurs in 2002 or later and zero otherwise.[7] We estimate the models using OLS regressions with standard errors that allow for heteroskedasticity and clustering at the firm level. Our hypothesis predicts $\beta^{(3)} < 0$ (i.e., a decrease in CAPEX following SOX). Based on the findings in the literature that overconfident managers tend to invest more heavily, we expect $\beta^{(2)} > 0$.

The regression results are provided in Table 3. First, we estimate the regression using industry dummies, λ_j, and year dummies, ϕ_t. The regression results support our hypothesis: the coefficient on "Confidence" in Model M1 of Table 3 is positive (i.e., $\beta^{(2)} = +1.883$), whereas the coefficient associated with the interaction term, "Confidence × SOX" is negative (i.e., $\beta^{(3)} = -1.401$). Both are significant at less than 1%. These results indicate that prior to SOX, overconfident CEOs tended to invest more capital relative to other CEOs in their industry. After the passage of SOX, however, overconfident CEOs sharply cut capital expenditures, bringing them much closer to other firms in their industries ($= +0.483 = 1.883 - 1.401$). Thus, SOX appears to have had a significant moderating effect on capital expenditures by overconfident CEOs. As we have discussed, SOX could lead to such moderation by bringing in more independent directors, thereby facilitating diverse opinions and, possibly, candid discussions among board members. Therefore, we might expect the board to question expenditures that appear to be driven more by the CEO's behavioral biases than by clear economic opportunities, thereby prodding the firm's investments closer to industry levels.

In Model M2 we replace our continuous measure of CEO overconfidence (i.e., the variable *Confidence*) with the binary measure of the CEO's overconfidence, *ConfidenceTopQ*, which equals one if the CEO's confidence measure is in upper quartile of the sample for that year and zero otherwise. We find qualitatively similar results using this measure.

The results are similarly supportive of our hypothesis when we estimate the regressions in equation 1 with firm fixed effects in place of industry fixed effects (see e.g., Models M3 and M4). For instance, in Model M3, the estimated coefficient on *Confidence* is positive (i.e., $\beta^{(2)} = 1.450$), and the coefficient on *Confidence* × *SOX* is negative (i.e., $\beta^{(3)} = -0.912$), indicating

[7] Clearly, it is not possible to estimate a regression with all year fixed effects and the SOX indicator. Thus, the requisite number of year fixed effects are omitted from the model, when estimating the regression.

Table 3
CEO overconfidence, SOX, and capital investments

	CAPEX (t+1)/assets (t) × 100			
	M1	M2	M3	M4
a: Confidence (t)	1.883***		1.450***	
	[0.000]		[0.000]	
b: ConfidenceTopQ (t)		0.902***		0.614***
		[0.000]		[0.000]
c: SOX	0.153	−0.238	0.061	−0.265
	[0.431]	[0.173]	[0.946]	[0.768]
a × **c**	−1.401***		−0.912***	
	[0.000]		[0.003]	
b × **c**		−0.674***		−0.350**
		[0.000]		[0.043]
CEO-related controls				
CEO bonus/salary	0.033	0.042*	0.059*	0.067**
	[0.192]	[0.093]	[0.052]	[0.027]
ln(Tenure(t))	−0.009	0.005	0.015	0.028
	[0.769]	[0.876]	[0.762]	[0.581]
ln(CEO age (t))	−0.846***	−0.863***	−0.548	−0.575
	[0.000]	[0.000]	[0.200]	[0.179]
CEO%Own(t)	1.331*	1.169*	3.172**	3.063**
	[0.057]	[0.096]	[0.039]	[0.046]
Firm-related controls				
ln(assets(t))	−0.135***	−0.127***	−1.377***	−1.389***
	[0.000]	[0.000]	[0.000]	[0.000]
LT Debt/ assets(t)	−0.158	−0.178	−2.587***	−2.615***
	[0.450]	[0.401]	[0.000]	[0.000]
R&D/sales (t)	−1.033***	−1.037***	3.455***	3.498***
	[0.009]	[0.009]	[0.001]	[0.001]
EBIT/assets (t)	2.263***	2.394***	6.752***	6.960***
	[0.000]	[0.000]	[0.000]	[0.000]
Intangibles/assets (t)	−1.082***	−1.048***	1.829***	1.889***
	[0.000]	[0.000]	[0.000]	[0.000]
CAPEX/assets (t-1)	80.186***	80.387***	45.944***	46.135***
	[0.000]	[0.000]	[0.000]	[0.000]
Market-related controls				
Tobin's Q(t)	0.254***	0.277***	0.487***	0.522***
	[0.000]	[0.000]	[0.000]	[0.000]
Stock return (t)	1.489***	1.585***	0.788***	0.849***
	[0.000]	[0.000]	[0.000]	[0.000]
Stock std dev (t)	−11.804***	−12.010***	−12.767***	−12.907***
	[0.000]	[0.000]	[0.000]	[0.000]
Inst%Own (t)	0.212**	0.237***	0.282	0.327*
	[0.018]	[0.008]	[0.152]	[0.097]
Prop no trade days (t)	−1.214	−1.227	5.825	5.983
	[0.537]	[0.563]	[0.556]	[0.550]
Constant	5.092***	5.455***	14.724***	15.179***
	[0.000]	[0.000]	[0.000]	[0.000]
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes
Industry fixed effects	Yes	Yes	No	No
Observations	19,349	19,349	19,349	19,349
Adjusted R^2	72.10%	72.00%	35.30%	35.10%

Table 3 contains regression models that examine the relationship between CEO overconfidence, SOX, and CAPEX. The dependent variable is the firm's CAPEX in year $t+1$ scaled by its assets in year t. The Appendix contains the variable definitions. All models are OLS models that include firm/industry and year fixed effects, and use standard errors clustered by firm. The significance levels at 1%, 5%, and 10% are denoted by ***, **, and *, respectively.

that overconfident CEOs employ more capital prior to the passage of SOX but significantly reduce capital employed after the passage of SOX. These coefficients are highly significant.

The results are economically significant. From Model M2 in Table 3, the coefficient on *ConfidenceTopQ* is 0.902, whereas the coefficient on the interaction term, *ConfidenceTopQ* × *SOX* is -0.674, and both are highly statistically significant, suggesting that after the passage of SOX, the difference in CAPEX/Assets between the firms led by overconfident CEOs and other firms drops by around 3/4 (i.e., $\frac{-0.674}{0.902} \approx -0.747$). Further, the average CAPEX/Assets is around 5.8% in our sample. Similarly, in robustness tests in which we look at the effect of SOX in firms that were previously highly non compliant with its provisions (Table 11), we find that, for the median firm, the effect of overconfidence on CAPEX declines by 52.6%. Thus, SOX appears to have had an economically important effect on the repercussions of CEO overconfidence.

3.1.2 Asset growth and SG&A expenses following SOX. Next we examine the growth in the assets of firms managed by overconfident CEOs, and the changes therein following SOX. We expect overconfident CEOs, with their overly positive views on firm prospects, to seek greater asset growth, whether measured by total assets or property, plant, and equipment.[8] Asset growth includes CAPEX, which was discussed in Section 3.1.1, but is also affected by the firm's policies such as its inventory management and payout. Excessive asset growth, for instance, through a high level of inventory or cash retention, may not contribute to shareholder value. We test for whether SOX helps to moderate (undesirable) growth in total assets, as well as in property, plant, and equipment, in the following equation:

$$\begin{aligned}\text{Asset Growth}_{i,(t,t+\tau)} = \alpha + \text{SOX}_{i,t}\beta^{(1)} + \text{Confidence}_{i,t}\beta^{(2)} \\ + \text{SOX}_{i,t} \times \text{Confidence}_{i,t}\beta^{(3)} + \mathbf{X}_{i,t}\theta + \eta_i + \phi_t + \varepsilon_{i,t}, \quad (2)\end{aligned}$$

where $\text{Asset Growth}_{i,(t,t+\tau)}$ represents the log increase in assets from year t to year $t+\tau$, (i.e., $\text{Asset Growth}_{i,(t,t+\tau)} = \ln\left[\frac{\text{Asset}_{t+\tau}}{\text{Asset}_t}\right]$), and similarly for PP&E growth. We estimate a panel regression using firm and year fixed effects and standard errors that are heteroskedasticity-consistent and clustered by firm. The results with industry dummies instead of firm fixed-effects are similar and are not reported for brevity.

We report the regression results in Table 4 in Models M1 to M4. As conjectured, we find that the coefficient associated with the interaction terms *Confidence* × *SOX* (−0.087 and −0.069), as well as the coefficients associated with the interaction term *ConfidenceTopQ* × *SOX* (−0.042, and −0.021) are

[8] The reason to look at growth rates rather than scaled asset or scaled PPE is because it is unclear as to what variable may be appropriate for scaling.

Table 4
CEO overconfidence, SOX, and asset growth, PP&E growth, and SG&A

Dependent variable	$ln\left(\frac{PPE(t+1)}{PPE(t)}\right)$		$ln\left(\frac{Assets(t+1)}{Assets(t)}\right)$		$\frac{SG\&A(t+1)}{Sale(t)}$	
	M1	M2	M3	M4	M5	M6
a: Confidence (t)	0.099***		0.042**		0.004	
	[0.000]		[0.013]		[0.318]	
b: ConfidenceTopQ (t)		0.044***		0.001		0.001
		[0.000]		[0.916]		[0.638]
c: SOX	0.007	−0.017	0.141***	0.123***	−0.001	−0.006**
	[0.820]	[0.589]	[0.001]	[0.002]	[0.921]	[0.050]
a × **c**	−0.087***		−0.069***		−0.013***	
	[0.000]		[0.000]		[0.008]	
b × **c**		−0.042***		−0.021*		−0.004*
		[0.000]		[0.053]		[0.054]
ln(Assets(t))					−0.002***	−0.001∗∗
					[0.008]	[0.016]
SG&A/sales (t)					0.572***	0.945***
					[0.000]	[0.000]
CEO-related controls	Yes	Yes	Yes	Yes	Yes	Yes
Other firm-related controls	Yes	Yes	Yes	Yes	Yes	Yes
Market-related controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	18,145	18,145	19,380	19,380	15,778	15,778
Adjusted R^2	9.40%	9.20%	17.00%	16.90%	32.30%	92.30%

Table 4 contains regressions that examine the relationship between CEO overconfidence, SOX, and various asset growth. The column header states the dependent variable. The Appendix contains the variable definitions. All models are OLS models that include firm and year fixed effects, and use standard errors clustered by firm. Brackets contain p-values, and superscripts ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

negative in sign and statistically significant. Thus, in the pre-SOX era, it appears that overconfident CEOs tended to grow the assets of their firms more rapidly than their industry peers did. However, post-SOX, their asset growth fell more in line with that of other firms in their respective industries.

In addition, we examine the effect of SOX on SG&A following Chen, Gores, and Nasev (2013). Their argument is that overconfident CEOs tend to overspend on the SG&A account, given their excessively positive views about the future demand for their products. The results in the last two columns of Table 4 suggest that overconfident CEOs were not necessarily overspending on SG&A prior to SOX, because the coefficients on *Confidence* and *ConfidenceTopQ* are not statistically significant in Model M5 and M6. However, consistent with our conjecture, it appears that SOX did tend to lower SG&A, as indicated by the negative and significant coefficients on the interaction terms *Confidence* × *SOX* and *ConfidenceTopQ* × *SOX*.[9]

These results are also economically significant. Focusing on Model M2 of Table 4, prior to SOX, overconfident CEOs grew PP&E at the rate of 4.5% (i.e., $(e^{0.044} - 1) \times 100$) faster than other nonoverconfident CEOs. Whereas, SOX

[9] The R-squared in the models is high. This arises because we control for lagged SG&A and we know from Chen, Gores, and Nasev (2013) that SG&A is sticky. The R-squared are low in models that use firm dummies because firm dummies consume many more degrees of freedom compared with the regressions with industry dummies.

reduces this differential in PP&E growth to just 0.2% (i.e., $(e^{0.044-0.042}-1)\times 100$). Further, focusing on the set of firms who were highly noncompliant with SOX's provisions prior to its passage (Table 11), for the median firm, SOX reduced the effect of overconfidence by 39.7%. This suggests that SOX encouraged overconfident CEOs to bring their rate of growth in various assets more in line with that of other nonoverconfident CEOs.

3.1.3 Sensitivity of investment to cash flows. We next examine how SOX effects a firm's investment sensitivity to cash flows. Malmendier and Tate (2005) find that overconfident CEOs spend more of their cash flows on capital expenditures. Based on our hypotheses, we expect SOX to restrain excessive spending by overconfident CEOs and, hence, expect the investment by overconfident CEOs to become less sensitive to cash flows post-SOX. We examine the sensitivity of expenditure in year t to cash flow in that year within a framework similar to that in Malmendier and Tate (2005). This type of investment-cash-flow sensitivity model has been widely studied in the literature (see e.g., Almeida, Campello, and Weisbach 2004; Hovakimian 2009; Fazzari, Hubbard, and Petersen 1988; Fazzari, Hubbard, and Petersen 2000).[10] Specifically, we run regressions of the following form:

$$\begin{aligned}\text{CAPEX/Assets}_{i,t} = {} & \alpha + \text{SOX}_{i,t}\beta^{(1)} + \text{Confidence}_{i,t}\beta^{(2)} \\ & + \text{SOX}_{i,t}\times\text{Confidence}_{i,t}\beta^{(3)} + \text{SOX}_{i,t}\times\text{Cash Flow}_{i,t}\beta^{(4)} \\ & + \text{Confidence}_{i,t}\times\text{Cash Flow}_{i,t}\beta^{(5)} \\ & + \text{SOX}_{i,t}\times\text{Confidence}_{i,t}\times\text{Cash Flow}_{i,t}\beta^{(6)} \\ & + \mathbf{X}_{i,t}\theta + \lambda_{j(i)} + \phi_t + \varepsilon_{i,t}. \end{aligned} \tag{3}$$

Here, *Cash Flow* represents one of the two measures of cash flows: EBIT/Assets and OCF/Assets; $\mathbf{X}$ is a vector of control variables; and ϕ_t, and $\lambda_{j(i)}$ represent year, and industry (firm) fixed effects, respectively. We anticipate a negative sign on $\beta^{(6)}$, which would suggest that SOX attenuates the tendency of overconfident CEOs to invest.

The results are in Table 5. Consistent with Malmendier and Tate (2005), we find that overconfident CEOs do indeed spend more of their cash flows. However, the coefficient on the triple-interaction term, $\beta^{(6)}$, is negative and statistically significant in Models M1 to M4, and is negative and mostly significant in Models M5 to M8. This suggests that SOX attenuates the tendency of overconfident CEOs to invest out of cash flows.

[10] The investment cash-flow sensitivity models have received some criticism as measures of financial constraints. However, we do not use the model to measure financial constraints (see e.g., Chen and Chen (2012), Kaplan and Zingales (1997)). We use the model to analyze the tendency of overconfident CEOs to spend available cash flows, as per Malmendier and Tate (2005).

Table 5
CEO overconfidence, SOX, and sensitivity of investment to cash flows

Depenent variable	CAPEX (t+1) /assets (t)							
Model	M1	M2	M3	M4	M5	M6	M7	M8
a: Confidence (t)	0.013***		0.005		0.009**		0.000	
	[0.000]		[0.138]		[0.020]		[0.988]	
b: ConfidenceTopQ (t)		0.007***		0.003		0.006**		0.000
		[0.007]		[0.252]		[0.024]		[0.848]
c: SOX	−0.017***	−0.018***	−0.018**	−0.018**	−0.014*	−0.015*	−0.018**	−0.016**
	[0.000]	[0.000]	[0.022]	[0.020]	[0.089]	[0.069]	[0.030]	[0.039]
d: EBIT/assets (t)	0.012	0.029***	0.034***	0.056***				
	[0.319]	[0.006]	[0.010]	[0.000]				
e: OCF/assets (t)					0.096***	0.116***	0.055***	0.080***
					[0.000]	[0.000]	[0.000]	[0.000]
a × **c**	0.004		0.006		0.001		0.011**	
	[0.347]		[0.115]		[0.758]		[0.012]	
a × **d**	0.057***		0.067***					
	[0.006]		[0.005]					
a × **c** × **d**	−0.095***		−0.094***					
	[0.002]		[0.001]					
b × **c**		0.003		0.002		−0.001		0.005*
		[0.366]		[0.317]		[0.840]		[0.068]
b × **d**		0.026		0.022				
		[0.104]		[0.148]				
b × **c** × **d**		−0.053***		−0.038**				
		[0.010]		[0.028]				
a × **e**					0.064***		0.080***	
					[0.003]		[0.001]	
a × **c** × **e**					−0.055*		−0.093***	
					[0.094]		[0.001]	
b × **e**						0.022		0.028*
						[0.152]		[0.067]
b × **c** × **e**						−0.021		−0.041**
						[0.311]		[0.015]
c × **d**	0.029**	0.011	0.024	0.001				
	[0.025]	[0.287]	[0.106]	[0.904]				
c × **e**					0.007	−0.010	0.003	−0.020*
					[0.617]	[0.385]	[0.826]	[0.091]
CEO-related controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-related controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Market-related controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
Industry fixed effects	Yes	Yes	No	No	Yes	Yes	No	No
Observations	21,714	21,714	21,714	21,714	21,267	21,267	21,267	21,267
Adjusted R^2	48.70%	48.60%	15.90%	15.60%	50.00%	49.90%	16.60%	16.30%

Table 5 contains regressions that examine how SOX attenuates the sensitivity of investment to cash flows by overconfident CEOs. The dependent variable is the firm's CAPEX in year $t+1$ scaled by its assets in year t. (following Malmendier and Tate (2005)). The Appendix contains the variable definitions. All models are OLS models that include firm/industry and year fixed effects, and use standard errors clustered by firm. Brackets contain p-values, and superscripts ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

3.2 Does SOX reduce overconfident CEOs' risk taking tendencies?

Next we examine firms' exposure to risk—both systematic, or market risk, and unsystematic, or firm specific risk—under overconfident CEOs. We test for whether overconfident CEOs moderate their firm's level of risk exposure post-SOX. Our hypothesis is that overconfident CEOs tend to underestimate the risk associated with their investment projects. Thus, firms under their control may

assume an excessive level of risk. We argue that after the passage of SOX, a relatively more independent board and independent audit committee, and/or a mandate for more disclosure, leads to an environment in which it is less feasible for overconfident CEOs to have the firm take on higher levels of risk.

We examine two different types of risk: exposure to market risk (measured by beta) and the level of idiosyncratic, or firm specific risk (as per Low 2009). We estimate beta by running a single-index model over the course of the year, using daily data. The proxy for idiosyncratic risk is the mean squared error (MSE) from that single-index model. When examining MSE, we take logs to mitigate concerns about skewness. The model is of the following form:

$$\begin{aligned}\text{Risk}_{t+1} = \alpha + \text{SOX}_{i,t}\beta^{(1)} + \text{Confidence}_{i,t}\beta^{(2)} + \text{SOX}_{i,t} \times \text{Confidence}_{i,t}\beta^{(3)} \\ + \mathbf{X}_{i,t}\theta + \lambda_{j(i)} + \phi_t + \varepsilon_{i,t},\end{aligned} \tag{4}$$

where *Risk* can be either beta or ln(MSE), **X** represents a set of firm and CEO control variables, and ϕ_t and $\lambda_{j(i)}$ are year and industry (firm) dummies, respectively. We cluster standard errors by firm.

The results are reported in Table 6. The results for market risk (beta) are in Models M1 to M4, and the results for idiosyncratic risk (ln(MSE)) are in Models M5 to M8. We find that coefficients associated with the variable *Confidence* as well as the variable *ConfidenceTopQ* are positive and highly significant in all of the models. This suggests that overconfident CEOs expose their firms to relatively more market risk as compared with their industry peers.

However, after the passage of SOX, these overconfident CEOs tend to reduce the level of risk exposure considerably. For instance, in Models M2 and M4 with firm and year fixed effects, the coefficients associated with the interaction terms *Confidence* $\times$*SOX* and *ConfidenceTopQ* $\times$ *SOX* are both negative and statistically significant at the less than 1% level (-0.176 and -0.106). In Models M1 and M3 where we use industry and year dummies, the coefficients associated with the interaction terms are similarly negative and significant.

These results hold for firm specific risk, as well. For example, in Models M6 and M8 where we use firm and year dummies, the coefficients associated with the interaction terms *Confidence* $\times$*SOX* and *ConfidenceTopQ* $\times$ *SOX* are both negative and statistically significant at the less than 1% level (-0.059 and -0.038). In Models M5 and M7 where we replace firm dummies with two-digit SIC industry dummies, the coefficients are negative and significant, as well. Therefore, SOX appears to have a significant moderating effect on the risk taking tendencies of overconfident CEOs.

The reduction in both beta and idiosyncratic risk is economically significant. For beta, focusing on the indicator measure of overconfidence, Model M3 in Table 6 indicates that prior to the passage of SOX, betas (βs) of firms led by overconfident CEOs were around 0.181 points higher than those of otherwise comparable firms. Given that the average beta in our sample is 1.2, this is an economically large (about 15%) additional exposure to market risk.

Table 6
CEO overconfidence, SOX, and firm's risk-taking strategies

Dependent variable	Beta (t+1)				Ln(MSE(t+1))			
	M1	M2	M3	M4	M5	M6	M7	M8
a: Confidence (t)	0.357***	0.260***			0.083***	0.076***		
	[0.000]	[0.000]			[0.000]	[0.000]		
b: ConfidenceTopQ (t)			0.181***	0.129***			0.068***	0.058***
			[0.000]	[0.000]			[0.000]	[0.000]
c: SOX	0.254**	−0.042	0.174	−0.097	−0.136***	−0.249***	−0.146***	−0.262***
	[0.027]	[0.732]	[0.128]	[0.424]	[0.001]	[0.000]	[0.000]	[0.000]
a × **c**	−0.331***	−0.176***			−0.042**	−0.059***		
	[0.000]	[0.003]			[0.022]	[0.007]		
b × **c**			−0.180***	−0.106***			−0.031***	−0.038***
			[0.000]	[0.000]			[0.002]	[0.000]
CEO-related controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-related controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Market-related controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	No	Yes	No	Yes	No	Yes	No
Firm fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
Observations	17,110	17,110	17,110	17,110	17,110	17,110	17,110	17,110
Adjusted R^2	49.40%	27.20%	49.10%	27.00%	74.30%	62.90%	74.40%	63.00%

Table 6 contains regressions that examine the relationship between CEO overconfidence, SOX, and firm's risk taking strategies. The column header states the dependent variable. The Appendix contains the variable definitions. All models are OLS models that include firm/industry and year fixed effects, and use standard errors clustered by firm. Brackets contain p-values, and superscripts ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

However, SOX appears to almost entirely erase this difference in market risk exposure. The results for idiosyncratic risk are similarly meaningful. Prior to SOX, overconfident CEOs had a 7.04% greater loading of idiosyncratic risk (i.e., $(e^{0.068}-1)\times 100$), whereas after the passage of SOX, these firms' loading of idiosyncratic risk is only 3.87% (i.e., $(e^{0.038}-1)\times 100$) more than that of otherwise comparable firms. Further, if we focus on the set of firms that were highly noncompliant with SOX prior to its passage (Table 11), for the median highly noncompliant firm, SOX reduced total risk by 33.06%. That is, the passage of SOX almost halves the effect of overconfidence on idiosyncratic risk.

4. SOX, Overconfidence, and Corporate Performance

Our analysis so far has focused on the role of SOX in mitigating the levels (or rates of growth) of investments and risk exposure of firms with overconfident CEOs. The question that naturally arises is whether these changes contribute to firm value. We conjecture that the increased discipline associated with SOX will induce CEOs to focus on value creating investments. For our measures of firm performance, we use both market and accounting based measures. We also examine industry-adjusted measures of performance and the S&P EQ.

4.1 Value effect of SOX on firms with overconfident CEOs

We use Tobin's Q and industry-adjusted Tobin's Q as proxies of firm value (as per Gompers, Ishii, and Metrick 2003; Bebchuk, Cohen, and Ferrell 2009). The proxies for operating performance are the firm's EBIT/Assets and industry-adjusted EBIT/Assets (following Powell and Stark 2005). The industry-adjusted Q (or EBIT/Assets) is the firm's Q (or EBIT/Assets) less the average Q (or EBIT/Assets) for all firms in its two-digit industry and year.

As in our earlier analysis, we examine the effect of SOX and overconfidence on firm value by constructing a firm-year panel of all companies in Compustat that have the necessary data. We run models with two-digit SIC code–based industry dummies and year dummies and also models with firm and year dummies. We cluster standard errors by firm. We also examine the salutary role of SOX on the effect of overconfidence on EQ. The models we estimate are of the following form:

$$\begin{aligned}\text{Performance}_{i,t+1} = {} & \alpha + \text{SOX}_{i,t}\beta^{(1)} + \text{Confidence}_{i,t}\beta^{(2)} \\ & + \text{SOX}_{i,t}\times\text{Confidence}_{i,t}\beta^{(3)} + \mathbf{x}_{i,t}\theta + \lambda_{j(i)} + \phi_t + \varepsilon_{i,t}, \quad (5)\end{aligned}$$

where *Performance* refers to either the firm's Tobin's Q or industry-adjusted Tobin's Q, the firm's EBIT/Assets or industry-adjusted EBIT/Assets, or *EQ* that refers to the firm's S&P EQ rating. The EBIT and Tobin's Q regressions are OLS regressions. For EQ, we obtain each company's S&P EQ variable from Compustat (Compustat code: spcsrc). The EQ variable ranks the firm's quality

from "A+" through to "D," with "A+" being the highest. We recode the original EQ variable to be a numerically ordered variable from 1 through to 8 (with a higher value representing better EQ) and run an ordered logit model.

The results for the EBIT models in Table 7 are consistent with our hypotheses. CEO overconfidence does not significantly influence earnings prior to SOX, as indicated by the insignificant coefficients on *Confidence* and *ConfidenceTopQ*. However, the coefficients associated with the interaction terms *Confidence* × *SOX* and *ConfidenceTopQ* × *SOX* are positive and highly significant. This suggests that SOX helps to redirect overconfident CEOs toward investments that create more shareholder wealth.

The results for Tobin's Q in Table 7 are consistent with our hypotheses. CEO overconfidence has little effect on Tobin's Q prior to the passage of SOX. The coefficients associated with the variables *Confidence* and *ConfidenceTopQ* are not generally statistically different from zero. However, after the passage of SOX, CEO overconfidence appears to influence firm performance for the better. We find that the coefficients associated with the interaction terms *Confidence* × *SOX* and *ConfidenceTopQ* × *SOX* are all positive and statistically significant.

The EQ models are presented in Models M9 and M10. As noted, the dependent variable is a discrete ordered variable that represents the company's S&P EQ. A positive coefficient on a variable indicates that it is associated with higher EQ. The results suggest that CEO overconfidence weakly but negatively affects EQ. After the passage of SOX, firms with overconfident CEOs appear to improve the EQ of their firms.

The effect of SOX on the relationship between overconfidence and both Q and EBIT/Assets is economically significant. Model M7 in Table 7 indicates that overconfident CEOs were associated with a 0.043-point lower Tobin's Q prior to SOX. However, after the passage of SOX, firms led by overconfident CEOs have 0.026-point larger Tobin's Q compared with those of otherwise comparable firms led by nonoverconfident CEOs. This is about a 5% increase in Q (given that the average Q is around 1.3). It is noteworthy that overconfident CEOs transition from having a negative effect to an economically zero-to-positive effect after SOX. The results are similar with respect to EBIT/Assets. Prior to SOX, overconfident CEOs' EBIT/Assets was not economically significantly different from that of other CEOs, whereas after SOX they were associated with a 0.005 larger EBIT/Assets relative to otherwise comparable firms led by nonoverconfident CEOs. Focusing on the effect of firms that were noncompliant with SOX prior to its passage (Table 11) for the median firm, SOX improved the effect of overconfidence on Q by around 13.87%. Overall, this suggests that SOX led to an economically meaningful improvement in the performance of overconfident CEOs' firms.

4.2 Effect on the value of R&D and CAPEX

Next, we study the effect of CEO overconfidence (before and after SOX) on values of R&D and CAPEX. This is important to interpreting our result

Table 7
CEO overconfidence, SOX, and effects on EBIT/assets, Tobin's Q and earning's quality

Dependent variable	EBIT/assets (t+1)				Tobin's Q (t+1)				Earnings quality (t+1)	
	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10
a: Confidence (t)	−0.004	−0.001			−0.072	0.084*			−0.136	
	[0.152]	[0.791]			[0.146]	[0.096]			[0.479]	
										−0.190*
b: ConfidenceTopQ (t)			0.000	0.000			−0.043	0.032		[0.082]
			[0.906]	[0.914]			[0.149]	[0.331]		
c: SOX	−0.015*	−0.014	−0.017*	−0.008	0.035	0.174***	0.047*	0.174***	−0.371***	−0.255***
	[0.089]	[0.146]	[0.088]	[0.421]	[0.265]	[0.000]	[0.090]	[0.000]	[0.000]	[0.000]
a x **c**	0.011***	0.022***			0.084	0.101*			0.831***	
	[0.001]	[0.000]			[0.114]	[0.083]			[0.000]	
b x **c**			0.005**	0.008***			0.069**	0.103***		0.368***
			[0.018]	[0.001]			[0.033]	[0.005]		[0.002]
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CEO-related controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-related controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Market-related controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	No	Yes	No	Yes	No	Yes	No	Yes	Yes
Firm fixed effects	No	Yes	No	Yes	No	Yes	No	Yes	No	No
Observations	19,366	19,366	19,366	19,366	19,378	19,378	19,378	19,378	17,021	17,021
R-squared	68.60%	33.30%	65.90%	29.00%	72.20%	34.40%	72.20%	34.50%	9.96%	9.85%

Table 7 contains regressions that examine the relationship between CEO overconfidence, SOX, firm value, as proxied by the firm's Tobin's Q, EBIT/Assets and S&P's Earnings Quality measure. We define the firm's Tobin's Q as its market capitalization divided by its book assets. The column header states the dependent variable. The Appendix contains the variable definitions. All models are OLS models that include firm/industry and year fixed effects, and use standard errors clustered by firm. Brackets contain p-values, and superscripts ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

that post-SOX, overconfident CEOs reduce CAPEX significantly. Hence, the question we would like to address is whether SOX helps to eliminate relatively wasteful expenditures. We do this analysis by using a triple-interaction term of *Confidence*×*SOX* times either CAPEX/Sales or R&D/Sales. We also, run separate regressions for the pre-SOX and post-SOX periods and observe the sign and significance of the double interaction term between *Confidence* and either CAPEX/Sales or R&D/Sales. The dependent variable in these models is the firm's industry-adjusted Tobin's Q in year $t+1$ (the results are robust to using straight Tobin's Q instead of industry adjusted Tobin's Q). For brevity, we only report models that include firm fixed effects and year fixed effects and cluster standard errors by firm. The results are similar in models with industry (instead of firm) fixed effects.

The results in Table 8 support the hypothesis that SOX positively moderates the effect of confidence on the value of R&D (in Panel A) and CAPEX (in Panel B). The triple-interaction terms *Confidence* × *SOX* × *R&D/Sales* and *ConfidenceTopQ* × *SOX* × *R&D/Sales* are 1.910 and 1.941, respectively—both positive and statistically significant at a less than 1% level. Further, the effect of CEO confidence on the value of R&D differs significantly between the pre-SOX and post-SOX periods. For example, the coefficient on *Confidence*× *R&D/Sales* is negative (−2.376) and highly significant in the pre-SOX period, whereas the same coefficient is positive though insignificant in the post-SOX period. Overall, this suggests that SOX significantly improves the effect of overconfidence on the value of R&D.

The results in Table 8 (Panel B) indicate that SOX influences positively the effect of CEO confidence on the value of CAPEX. As with Panel A, the key variables of interest are the triple-interaction terms in Models M1 and M4. Both triple-interaction terms are positive and significant at the 5% level. Further, whereas CEO overconfidence affects significantly negatively the value of CAPEX in the pre-SOX period (i.e., Models M2 and M5), it has an insignificant effect on value in the post-SOX period (i.e., Models M3 and M6). These results are consistent with the notion that SOX encourages overconfident CEOs to focus on value-enhancing capital expenditures.

SOX's effect on the value of CAPEX for overconfident CEOs is economically meaningful. If we focus on CAPEX and look at Model M4 in Table 8, the coefficient on is -0.563 on *ConfidenceTopQ* × *CAPEX/Sales* and the average CAPEX/Sales is 0.076, so the pre-SOX effect of overconfidence on the value of CAPEX is a 0.042-point reduction in Tobin's Q. This is about a 3.5% reduction in Tobin's Q, given that the average Tobin's Q for our sample is around 1.3. After the passage of SOX, by contrast, the coefficients on *ConfidenceTopQ* × *SOX* and *ConfidenceTopQ* × *SOX* × *CAPEX/Sales* are, respectively, 0.010 and 0.614. Thus, after SOX, at the average level of CAPEX expenditure, overconfident CEOs' CAPEX activity is associated with a 0.0139-point increase in Q. This implies that SOX increased the value of overconfident CEOs' CAPEX expenditure by 0.056 points. The important

Table 8
CEO overconfidence, SOX, and effects on value of R&D and CAPEX

Sample	All	Pre-SOX	Post-SOX	All	Pre-SOX	Post-SOX
Model	M1	M2	M3	M4	M5	M6
Panel A: Value of R&D						
a: Confidence (t)	0.161***	0.143**	0.144***			
	[0.004]	[0.045]	[0.003]			
b: ConfidenceTopQ (t)				0.129***	0.111***	0.070***
				[0.000]	[0.002]	[0.000]
c: SOX	0.320**			0.306**		
	[0.016]			[0.019]		
d: R&D/sales (t)	1.124**	1.164	0.590*	0.866**	0.8300	0.533*
	[0.016]	[0.111]	[0.075]	[0.024]	[0.233]	[0.076]
a × **c**	0.056					
	[0.379]					
a × **c** × **d**	1.910***					
	[0.008]					
b × **c**				−0.032		
				[0.338]		
b × **c** × **d**				1.941***		
				[0.000]		
a × **d**	−2.126***	−2.376***	0.148			
	[0.003]	[0.004]	[0.836]			
b × **d**				−1.457***	−1.466***	0.643
				[0.000]	[0.004]	[0.146]
All controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm & year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,378	7,423	11,955	19,378	7,423	11,955
R-squared	30.20%	15.20%	21.40%	30.30%	15.20%	21.60%
Panel B: Value of CAPEX						
a: Confidence (t)	0.162***	0.166**	0.145***			
	[0.004]	[0.021]	[0.007]			
b: ConfidenceTopQ (t)				0.101***	0.097**	0.082***
				[0.007]	[0.023]	[0.000]
c: SOX	0.319**			0.297**		
	[0.013]			[0.020]		
e: CAPEX/sales (t)	0.128	0.301	−0.150	−0.079	0.102	−0.182
	[0.452]	[0.296]	[0.252]	[0.584]	[0.678]	[0.149]
a × **c**	0.053					
	[0.447]					
a × **c** × **e**	1.067**					
	[0.015]					
b × **c**				0.0100		
				[0.797]		
b × **c** × **e**				0.614**		
				[0.023]		
a × **e**	−1.048***	−1.122**	0.039			
	[0.005]	[0.021]	[0.883]			
b × **e**				−0.563**	−0.599**	0.137
				[0.018]	[0.027]	[0.374]
All controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm & year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	19,378	7,423	11,955	19,378	7,423	11,955
Adjusted R^2	30.10%	14.70%	21.40%	30.00%	14.70%	21.50%

We analyze how SOX moderates the effect of CEO overconfidence on value of R&D (Panel A) and CAPEX (Panel B). The dependent variable is the firm's industry-adjusted Tobin's Q in year $t+1$. Columns 1 and 4 examine the whole sample, whereas Columns 2, 3, 5, and 6 examine pre-SOX and post-SOX sub-samples. The Appendix contains the variable definitions. All models are OLS models that include firm/industry and year fixed effects, and use standard errors clustered by firm. Brackets contain p-values, and superscripts ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

point here is that overconfident CEOs' CAPEX activity transitions from reducing firm value by about 3.5% to having an effect that is indistinguishable from zero.

4.3 Overconfidence and acquisitions

Next we look at acquisitions by overconfident CEOs. We analyze announcement returns over both short and long windows. Further, we look at posttakeover performance, as proxied by industry-adjusted Tobin's Q and EBIT/Assets. We expect SOX to encourage overconfident CEOs to create more value (or, at least, destroy less value) in acquisitions (Hypothesis 7). We examine this by collecting data on acquisitions made by firms for which we have the necessary data on executive compensation and governance. The acquisition must be announced between 1992 and 2011 to appear in the sample.

We start with an examination of the cumulative abnormal returns (CARs) over various event windows. The CARs are based an OLS estimation of the market model from 125 days to 375 days before the acquisition announcement. Figure 1 plots the CARs. The figure reveals that there is a significant negative preannouncement run up and postannouncement decline for acquisitions by overconfident CEOs. The decline is less negative for overconfident CEOs after SOX than it is before SOX. The preannouncement and postannouncement returns are largely consistent with prior studies, documenting a relatively low cumulative abnormal return for acquirers on average (as per Duchin and Schmidt 2013). We obtain similar results if we look at the subset of acquisitions of public targets, with acquisitions of publicly listed targets generally performing worse (as per Chang 1998; Fuller, Netter, and Stegemoller 2002). This figure does not control for other firm-level and deal-level factors that might drive acquisition performance, which leads us to conduct multivariate tests.

We examine the long-run postacquisition performance, as proxied by postacquisition BHAR, and industry-adjusted Tobin's Q, and industry-adjusted EBIT/Assets (see e.g., Healy, Palepu, and Ruback 1992; Powell and Stark 2005). The industry-adjusted Q values are the firm's value less the mean value for all companies in the firm's two-digit SIC industry and year. We control for factors that are standard in the literature for examining long-run posttakeover performance that are lagged as appropriate to ensure that they predate the acquisition announcement. We include year dummies and industry dummies, to account for the documented industry and time effects in mergers (see e.g., Powell and Yawson 2007; Harford 2005; Ovtchinnikov 2013) and cluster standard errors by firm.

The results for short-horizon windows are in Models M1 and M2 in Table 9. The dependent variable is the acquirer's short-run abnormal return on announcing the takeover. As in Malmendier and Tate (2005), CEO overconfidence is negatively related to acquisition performance. However,

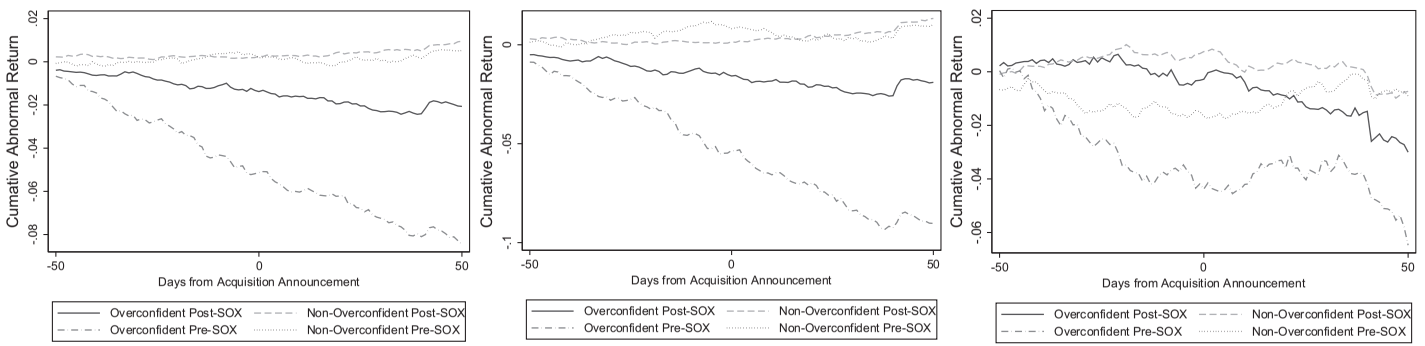


Figure 1
Cumulative abnormal returns to acquirers around takeover announcements
Figure 1 plots the cumulative abnormal returns from 50 days before the takeover to 50 days after the acquisition announcement. The abnormal returns are based on an OLS estimation of the market model over the period 125 to 375 days before the acquisition announcement. In *Panel A* we depict CARs around acquisitions of all targets, public as well as non-pubic U.S firms between the year 1992 and the year 2011. In *Panel B* we depict CARs around acquisitions of only publicly-traded targets between the year1992 and the year 2011. In *Panel C* we depict CARs around acquisitions of all non-public targets between the year 1992 and the year 2011.

Table 9
CEO overconfidence, SOX, and firm's acquisition strategy

Dependent variable	CAR		BHAR		Ind adj EBIT/assets		Ind adj Tobin's Q	
Time/Window	(-10, 10)		(-42, 125)		(t+1)		(t+1)	
	M1	M2	M3	M4	M5	M6	M7	M8
a: Confidence (t)	−0.022		−0.275***		−0.038***		−0.329**	
	[0.114]		[0.000]		[0.006]		[0.027]	
b: ConfidenceTopQ (t)		0.000		−0.086***		−0.018***		−0.188**
		[0.988]		[0.009]		[0.007]		[0.020]
c: SOX	−0.056***	−0.049***	−0.505***	−0.438***	0.006	0.021	−0.186	−0.068
	[0.000]	[0.001]	[0.000]	[0.000]	[0.748]	[0.285]	[0.254]	[0.607]
a × **c**	0.009		0.130*		0.047***		0.459***	
	[0.554]		[0.056]		[0.005]		[0.007]	
b × **c**		−0.001		0.048		0.022***		0.265***
		[0.892]		[0.183]		[0.004]		[0.004]
Diversifying deal	−0.007**	−0.007**	−0.030**	−0.030**	0.002	0.002	−0.005	−0.005
	[0.043]	[0.044]	[0.023]	[0.027]	[0.353]	[0.365]	[0.872]	[0.851]
Run up	−0.014***	−0.014***	−0.081**	−0.083**	0.009***	0.009***	0.191***	0.190***
	[0.002]	[0.002]	[0.022]	[0.018]	[0.000]	[0.000]	[0.000]	[0.000]
Tender offer	0.019***	0.019***	0.028	0.027	−0.005	−0.005	−0.110**	−0.115**
	[0.006]	[0.006]	[0.296]	[0.315]	[0.306]	[0.273]	[0.034]	[0.027]
Public target	−0.028***	−0.028***	−0.056***	−0.055***	0.005	0.005	0.083**	0.085**
	[0.000]	[0.000]	[0.003]	[0.004]	[0.231]	[0.220]	[0.018]	[0.016]
Cash only	0.009***	0.009***	0.02	0.019	0.005***	0.005***	0.021	0.020
	[0.007]	[0.007]	[0.137]	[0.149]	[0.004]	[0.005]	[0.391]	[0.420]
Rel deal size	0.005	0.005	−0.053	−0.054	−0.032***	−0.032***	−0.367***	−0.371***
	[0.626]	[0.629]	[0.254]	[0.251]	[0.006]	[0.006]	[0.000]	[0.000]
Ln(transaction value)	0.002	0.002	0.015***	0.015***	0.000	0.000	−0.010	−0.010
	[0.157]	[0.174]	[0.005]	[0.007]	[0.990]	[1.000]	[0.281]	[0.274]
All controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,262	5,262	5,262	5,262	4,704	4,704	4,707	4,707
Adjusted R^2	7.60%	7.50%	21.40%	20.70%	43.70%	43.50%	52.00%	52.00%

We analyze how SOX moderates the performance of overconfident CEOs' acquisition strategy. If acquisition is in the year $t+1$, then we use all explanatory variables from the year t. The column header states the dependent variable. The Appendix contains the variable definitions. All models are OLS models that include firm/industry and year fixed effects, and use standard errors clustered by firm. Brackets contain p-values, and superscripts ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

the relationship between CEO overconfidence and short-run returns is not statistically significant (consistent with Kolasinski and Li 2013).[11]

The results on long-horizon market performance are in Models M3–M6 of Table 9 and are consistent with the notion that SOX tends to enhance the value created in acquisitions by overconfident CEOs. CEO overconfidence is negatively related to long-term value creation, as proxied by BHARs. However, SOX affects positively the relationship between CEO overconfidence and long-term value creation from acquisitions. The results in relation to long-run operating performance (see e.g., Models M7 and M8) and long-run value (see e.g., Models M9 and M10) support the BHAR results. They indicate that although overconfident CEOs are associated with significantly lower postacquisition operating returns and market values, SOX helps to mitigate the effect of CEO overconfidence.

In unreported results, we examine further whether SOX influences the acquisitiveness of overconfident CEOs. We obtain the number and value of acquisitions that each firm does in each year, as reported in SDC Platinum. We find that even though overconfident CEOs have significantly more acquisitions and spend more on acquisitions, SOX does not influence acquisitiveness significantly. Thus, the results suggest that even though SOX did not reduce the number of acquisitions by overconfident CEOs, it did improve their value implications.

The economic significance of this analysis is evident from Figure 1. If we focus on the long-term effect of overconfidence on acquisitions, Model M8 of Table 9 suggests that whereas overconfident CEOs' acquisitions reduced Tobin's Q by 0.188 points, overconfident CEOs' acquisitions were associated with a relatively small increase in Q of 0.077 points after SOX, given that our sample average acquisition-related Tobin's Q is 1.6. Even though the increase in Tobin's Q is relatively small, the important point is that the acquisitions transition from a strongly negative (about −11%) effect on Tobin's Q to having a zero to weakly positive effect after the passage of SOX.

5. Overconfidence and Dividend Payout

The foregoing results indicate that SOX helped to attenuate investment by overconfident CEOs, but how did overconfident CEOs employ the capital that they did not spend? Deshmukh, Goel, and Howe (2013) indicate that overconfident CEOs are reluctant to pay dividends. However, if the company has no additional positive NPV projects and a lower or unchanged precautionary motive for cash holdings, our prediction is that it may be optimal to distribute at least part of the excess cash flow to shareholders. We examine whether SOX mitigated the reluctance of overconfident CEOs to pay dividends. We

[11] Specifically, the coefficient on *Confidence* is consistent with that on the analogous *Underdiversified* in Table 4 of Kolasinski and Li (2013).

Table 10
CEO overconfidence, SOX, and dividend payment

Dependent variable	$100 \times \frac{\text{Total Dividends (t+1)}}{\text{Assets (t+1)}}$			
	M1	M2	M3	M4
a: Confidence (t)	−0.145***	−0.232***		
	[0.000]	[0.000]		
b: ConfidenceTopQ (t)			−0.098***	−0.124***
			[0.000]	[0.000]
c: SOX	0.084**	−0.449***	0.103***	−0.390***
	[0.018]	[0.001]	[0.002]	[0.003]
a × **c**	0.081**	0.284***		
	[0.038]	[0.000]		
b × **c**			0.063***	0.147***
			[0.006]	[0.000]
CEO-related controls	Yes	Yes	Yes	Yes
Firm-related controls	Yes	Yes	Yes	Yes
Market-related controls	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	No	Yes	No	Yes
Industry fixed effects	Yes	No	Yes	No
Observations	19,012	19,012	19,012	19,012
Adjusted R^2	79.10%	30.30%	79.10%	30.30%

Table 10 contains OLS regression models that examine the relationship between CEO overconfidence, SOX, and firm's dividend payout strategy. The dependent variable is the firm's total dividend paymant scaled by its assets in year $t+1$. The Appendix contains the variable definitions. All models are OLS models that include firm/industry and year fixed effects, and use standard errors clustered by firm. Brackets contain p-values, and superscripts ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

use a regression approach similar to that employed in Section 4, in which we examine the effect of SOX on overconfident CEOs' dividend payments.

The results are in Table 10 and are consistent with our hypothesis. We find that the coefficients on the overconfidence measures, *Confidence* and *ConfidenceTopQ* are −0.232 and −0.124 in Models M2 and M4, which present models with firm and year dummies. This is consistent with the findings documented in Deshmukh, Goel, and Howe (2013) that overconfident CEOs prefer to limit dividend payments. Nevertheless, we also find that the coefficients associated with the interaction terms *Confidence* × *SOX* and *ConfidenceTopQ* × *SOX* are 0.284 and 0.147 in models where we control for firm fixed effects. The results are similar when we replace the firm dummies with two-digit SIC-code-based industry dummies. These results indicate that after the passage of SOX, overconfident CEOs started to pay significantly higher dividends.

There is, however, an important caveat that applies to these results: In 2001, the United States reduced the personal tax payable on dividends, potentially making dividends a more favorable way for companies to distribute cash.

6. Extensions and Robustness Tests

6.1 Pre-SOX voluntary compliance and overconfidence

We take further steps both to refine the paper's identification strategy and to shed more light on the particular provisions through which SOX moderated the effect

of overconfidence. We do this by examining the effect of SOX on companies that satisfied SOX's board and audit-committee independence requirements even before the passage of SOX, as compared with those companies that did not comply. A finding that SOX effects only the noncompliant firms would indicate that the improvements in board/audit-committee independence drive the moderation of CEO overconfidence. It is worth noting that some aspects of SOX, such as auditor requirements and CEO certification of financial reports, affected all (or virtually all) firms.[12] These "common" factors would tend to weigh *against* us finding significant differences between compliant and noncompliant firms. Further, because the sample contains only S&P 1500 firms (covered by Execucomp), there would be few, if any, firms that could seek an exemption to SOX's requirements (as such exemptions applied to small firms). Further, although it is possible that some firms delayed compliance with SOX, this would again weaken our ability to discern clear differences between compliant and noncompliant firms.

We cross validate our results by analyzing the effect of SOX on firms that already satisfied the board and audit committee requirements of SOX. We have argued that SOX enhanced the operations and value of firms with overconfident CEOs by improving governance and oversight. However, if our argument is valid, it should also imply that companies that were already compliant on these dimensions should see no improvement on the passage of SOX. We test this by examining separately the effect of SOX in the "compliant" firms and in the "noncompliant" firms. We define the compliant firms as those that had both a majority independent board and a fully independent audit committee before SOX (1998–2001).[13] The sample is restricted to companies that were listed during the SOX period. All firms that are not compliant are regarded as noncompliant. We focus on firms being compliant with SOX (Clark 2005). We then undertake several additional robustness tests.

6.1.1 Triple interaction tests. The first tests analyze the effect of SOX on overconfidence in noncompliant firms compared with the effects on compliant firms. We focus on highly noncompliant firms (i.e., those that were further away from compliance, which we define in the next paragraph) because these firms were more likely to have been affected by the passage of SOX. In the following subsection we also explore subsamples of firms that were merely noncompliant (as opposed to highly noncompliant) and compare them with compliant firms.

We start by determining if the firm complied with SOX's board and audit committee requirements prior to its passage. For the noncompliant firms, we then calculate the "distance" between the board's proportion of independent

[12] We are not aware of any firms that had explicitly adopted such provisions prior to SOX.

[13] We require compliance in all 4 years because firms that became compliant in 2001 might have been influenced by the legislative deliberations or public discussion prior to actual passage of SOX.

directors and having a majority independent board (the "independence gap"). We then determine whether the firm's independence gap is above median or in the top quartile for the set of noncompliant firms. We find that, based on the board-independence requirement, these highly noncompliant firms had to increase the proportion of independent members by around 20% to comply with SOX. Next, we create two definitions of being "highly noncompliant": Definition 1 involves having an independence gap that is above median; Definition 2 involves having an independence gap in the top quartile.[14] Finally, we run triple-interaction regressions of the following form:

$$\begin{aligned} y = {} & \beta^{(1)}\text{Confidence} + \beta^{(2)}\text{HNC} + \beta^{(3)}\text{SOX} + \beta^{(4)}\text{Confidence} \times \text{HNC} \\ & + \beta^{(5)}\text{Confidence} \times \text{SOX} + \beta^{(6)}\text{HNC} \times \text{SOX} \\ & + \beta^{(7)}\text{Confidence} \times \text{HNC} \times \text{SOX} + \mathbf{x}\theta + \varepsilon, \end{aligned}$$

where, *HNC* denotes an indicator that equals one if the firm is "highly noncompliant" according to one of the two aforementioned definitions and equals zero otherwise, *SOX* is an indicator for whether the observation postdates 2002, and *Confidence* denotes our continuous confidence measure.[15]

The results for Definition 1 (i.e., above median in terms of the distance from having a majority independent board) are reported in Table 11. The results for Definition 2 (i.e., in the top quartile in terms of the distance from having a majority independent board) are reported in Table 12. The results highlight that SOX affected mainly the set of highly noncompliant firms. Specifically, for the most part, the coefficients on the triple-interaction terms in Tables 11 and 12 have the appropriate sign and significance: for the highly noncompliant firms (but not the other firms), SOX is associated with a significant reduction in investment and risk (variance and MSE) in firms run by overconfident CEOs and a significant increase in EBIT/Assets and Tobin's Q.

For two of the variables, systematic risk (beta) and dividend payout, there is no significant difference between compliant firms and highly noncompliant firms. As noted, some requirements of SOX were new to all (or most) of the firms. In the case of dividends, as noted earlier, an important caveat is that SOX occurred around the same time as the dividend tax cuts; this could have influenced all firms with low dividends, a relatively common characteristic in firms with overconfident CEOs.

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[14] In our tests, we exclude the "slightly" noncompliant firms from our sample and include only compliant firms, which we compare against highly noncompliant firms. The results are qualitatively the same if we include the "slightly" noncompliant firms in the sample.

[15] Note that in regression models in which the firm is merely noncompliant, as opposed to highly noncompliant, the coefficient on the triple interaction $\left(\beta^{(7)}\right)$ is qualitatively similar, but often insignificant, suggesting that the effect of SOX concentrates in those firms that must make significant changes to their board.

Table 11
Model with triple interactions: Highly noncompliant firms–Definition 1 (firms with an above-median deficit of independent directors before SOX)

Dependent variable	CAPEX/ assets	PP&E growth (t, t+1)	asset growth (t, t+1)	EBIT/ assets	Tobin's Q	Beta	Total variance	MSE	Dividends/ assets
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
a: Confidence	2.474***	0.177***	0.168***	0.069***	−0.050	0.388***	0.312***	0.143***	−0.162***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.382]	[0.000]	[0.000]	[0.000]	[0.000]
b: SOX	−0.533***	0.036***	0.062***	0.002	0.034	0.209***	−0.113***	−0.184***	0.041
	[0.002]	[0.002]	[0.000]	[0.774]	[0.231]	[0.000]	[0.001]	[0.000]	[0.127]
c: Highly noncompliant	0.035	0.027***	0.019***	−0.014***	−0.070***	0.030	0.003	−0.004	−0.013
	[0.797]	[0.000]	[0.009]	[0.002]	[0.005]	[0.281]	[0.918]	[0.773]	[0.500]
a × **c**	−0.005	0.091**	0.139***	−0.045**	−0.374***	0.088	−0.085	−0.047	0.066
	[0.992]	[0.019]	[0.000]	[0.024]	[0.007]	[0.454]	[0.355]	[0.290]	[0.329]
a × **b**	−1.476***	−0.082***	−0.123***	−0.014	−0.103	−0.208**	0.003	0.035	0.072
	[0.000]	[0.002]	[0.000]	[0.260]	[0.129]	[0.010]	[0.963]	[0.291]	[0.188]
b × **c**	0.244	−0.021**	−0.019*	0.003	0.056*	0.024	−0.069**	−0.014	0.043
	[0.195]	[0.045]	[0.077]	[0.628]	[0.064]	[0.453]	[0.029]	[0.408]	[0.143]
a × **b** × **c**	−0.749**	−0.073***	−0.057***	0.018*	0.150***	0.003	−0.118*	−0.057*	0.012
	[0.017]	[0.000]	[0.003]	[0.054]	[0.006]	[0.951]	[0.064]	[0.074]	[0.859]
All other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,758	14,593	15,784	15,770	15,783	13,801	13,801	13,801	15,449
Adjusted R^2	0.553	0.130	0.148	0.299	0.694	0.335	0.511	0.529	0.758

Table 11 contains regressions that examine the set of highly noncompliant firms. We define firms as noncompliant if they do not have both a majority independent board and a fully independent audit committee between 1998 and 2001. Next, we define a firm as highly noncompliant if a noncompliant firm belongs to the above-medium group of firms as per the distance from a majority independent board prior to implementation of SOX. The Appendix contains the variable definitions. All models are OLS models that include firm/industry and year fixed effects, and use standard errors clustered by firm. Brackets contain p-values, and superscripts ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

Table 12
Model with triple interactions: Highly noncompliant firms–Definition 2 (firms with a top-quartile deficit of independent directors before SOX)

Dependent variable	CAPEX/ assets	PP&E growth (t, t+1)	asset growth (t, t+1)	EBIT/ assets	Tobin's Q	Beta	Total variance	MSE	Dividends/ assets
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
a: Confidence	2.500***	0.179***	0.173***	0.069***	−0.040	0.378***	0.261***	0.107***	−0.164***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.507]	[0.000]	[0.000]	[0.000]	[0.000]
b: SOX	−0.457***	0.038***	0.065***	0.002	0.038	0.210***	−0.147***	−0.210***	0.042
	[0.008]	[0.002]	[0.000]	[0.730]	[0.194]	[0.000]	[0.000]	[0.000]	[0.128]
c: Highly noncompliant	−0.146	0.028***	0.019**	−0.015***	−0.073***	0.037	0.027	0.016	−0.015
	[0.293]	[0.000]	[0.011]	[0.001]	[0.005]	[0.184]	[0.292]	[0.220]	[0.442]
a × **c**	−0.078	0.098**	0.147***	−0.045**	−0.365***	0.078	−0.100	−0.056	0.073
	[0.880]	[0.016]	[0.000]	[0.024]	[0.009]	[0.520]	[0.271]	[0.199]	[0.291]
a ×— **b**	−1.745***	−0.086***	−0.128***	−0.014	−0.115	−0.204**	0.103	0.111***	0.066
	[0.000]	[0.002]	[0.000]	[0.264]	[0.104]	[0.015]	[0.145]	[0.001]	[0.239]
b × **c**	0.376**	−0.027**	−0.020*	0.003	0.060**	0.006	−0.088***	−0.028	0.051*
	[0.049]	[0.012]	[0.079]	[0.537]	[0.049]	[0.864]	[0.008]	[0.106]	[0.092]
a ×— **b** × **c**	−0.618*	−0.063***	−0.057***	0.020**	0.156***	0.020	−0.141**	−0.078**	−0.013
	[0.053]	[0.000]	[0.004]	[0.040]	[0.006]	[0.697]	[0.035]	[0.022]	[0.841]
All other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,664	13,505	14,688	14,674	14,687	12,782	12,782	12,782	14,364
Adjusted R^2	0.540	0.134	0.150	0.299	0.693	0.332	0.501	0.508	0.751

Table 12 contains regressions that examine the set of highly noncompliant firms. We define firms as noncompliant if they do not have both a majority independent board and a fully independent audit committee between 1998 and 2001. Next, we define a firm as highly noncompliant if a noncompliant firm belongs to the top quartile of firms as per the distance from a majority independent board prior to implementation of SOX. The Appendix contains the variable definitions. All models are OLS models that include firm/industry and year fixed effects, and use standard errors clustered by firm. Brackets contain p-values, and superscripts ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

Further we undertake these triple-interaction tests in the context of our M&A results in Table 13. The key finding here is that the coefficient on the triple-interaction is statistically significant, and is positive, suggesting that the effects SOX on takeovers by overconfident firms concentrate in the set of firms who were highly noncompliant (i.e., those firms who had to make the greatest changes to improve governance following SOX).

In additional (unreported) tests, we obtain similar results if we look at the set of firms that make above-median or top-quartile changes in the proportion of independent directors (as opposed to being above median or top quartile in terms of the distance from having a majority of independent directors prior to SOX).

Naturally, one consideration here is whether the highly noncompliant firms are significantly different in characteristics from other firms. Intuitively, they should not be: requiring Execucomp data restricts the analysis to the S&P 1500, ensuring that the firms are all relatively large. Nonetheless, in Online Appendix Table OA1, we report firm-average characteristics for both the firms that are highly noncompliant and those that are not (following Definition 1 of being highly noncompliant). The differences between firms that were highly noncompliant with SOX and those that were not are usually statistically significant (using either a t-test or a nonparametric rank-sum test). However, the differences are economically small in magnitude. For example, there is no economically significant difference in the proportion of no-trade days, and the firms are of similar size in terms of economic magnitude (even though the difference is statistically significant). Thus, the characteristics of the firms are qualitatively similar, suggesting that systematic differences between firms are unlikely to drive the results.

As indicated above, the coefficient on the triple-interaction is typically statistically insignificant if we look at whether the firm was merely noncompliant (as opposed to being highly noncompliant). Nonetheless, we explore next whether there are significant differences following SOX in the merely noncompliant sample by undertaking sub sample tests.

6.1.2 Compliant/noncompliant comparison. We analyze the effect of SOX on overconfident managers for compliant and noncompliant firms, using both the continuous measure of overconfidence (*Confidence*) and the indicator variable (*ConfidenceTopQ*). The results are unreported for brevity. However, we find that the relevant SOX interaction terms are statistically significant only in the noncompliant sample (and in the highly noncompliant sample). They are not significant in the compliant sample. This is the case for both our panel regressions and for our M&A regressions. Overall, these results imply that the key mechanism of action is the change in board composition. The theory behind this is that the increased board-independence forces CEOs to consider other nonoverconfident views and also prevents overconfident CEOs from acting on their overconfident beliefs.

Table 13
Triple interaction models–CEO overconfidence, highly noncomplaint firms, and M&A performance

Dependent	CAR (−10, 10)	CAR (−10, 10)	BHAR (−42, 125)	BHAR (−42, 125)	Ind adj EBIT/ assets	Ind adj EBIT/ assets	Ind adj Tobin's Q	Ind adj Tobin's Q
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
a: Confidence	−0.021		−0.311***		−0.026***		−0.089	
	[0.187]		[0.000]		[0.004]		[0.460]	
b: ConfidenceTopQ		−0.001		−0.118***		−0.014***		−0.137***
		[0.866]		[0.000]		[0.000]		[0.004]
c: SOX	0.006	0.004	0.103***	0.079***	0.014***	0.013***	0.045	0.007
	[0.331]	[0.491]	[0.000]	[0.000]	[0.000]	[0.000]	[0.338]	[0.860]
d: Highly noncompliant	0.001	−0.009	0.106***	−0.001	0.013***	0.001	0.139**	0.056
	[0.863]	[0.162]	[0.002]	[0.976]	[0.010]	[0.713]	[0.031]	[0.247]
a × **c**	−0.011		−0.129***		0.004		0.017	
	[0.291]		[0.002]		[0.553]		[0.829]	
a × **d**	−0.019		−0.299***		−0.033***		−0.204**	
	[0.140]		[0.000]		[0.000]		[0.043]	
b × **c**		−0.005		−0.071***		0.005		0.134***
		[0.390]		[0.002]		[0.169]		[0.003]
b × **d**		0.003		−0.091***		−0.011**		−0.032
		[0.734]		[0.004]		[0.019]		[0.591]
c × **d**	−0.007	0.006	−0.151***	−0.021	−0.016**	−0.003	−0.107	0.008
	[0.510]	[0.426]	[0.000]	[0.512]	[0.010]	[0.515]	[0.182]	[0.893]
a × **c** × **d**	0.031		0.389***		0.041***		0.286*	
	[0.103]		[0.000]		[0.000]		[0.055]	
b × **c** × **d**		0.003		0.113**		0.016**		0.034
		[0.816]		[0.014]		[0.016]		[0.698]
All other controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,262	5,262	5,262	5,262	4,704	4,704	4,707	4,707
Adjusted R^2	0.034	0.033	0.086	0.082	0.416	0.415	0.553	0.554

Table 13 contains regressions that examine the M&A performance of overconfident CEOs split by whether the firm was highly noncompliant with SOX prior to the passage of SOX. We define firms as highly noncompliant if they were both noncompliant with independent board and independent audit committee and also they were in the top median in terms of their distance from having a majority independent board members. The Appendix contains the variable definitions. All models are OLS models that include firm/industry and year fixed effects, and use standard errors clustered by firm. Brackets contain p-values, and superscripts ***, **, and * denote significance at 1%, 5%, and 10%, respectively.

6.1.3 Alternative SOX indicator equalling one only if firm was noncompliant prior to SOX. We also check that the results are robust to using an alternative SOX indicator, SOX^*, that equals one if the observation is post-SOX and the firm was not previously compliant with SOX and equals zero otherwise (i.e., if the observation predates SOX or if the firm was previously SOX compliant). This indicator helps to distinguish the treated group (i.e., those that were not compliant with SOX) from the control (i.e., compliant) group. This follows a similar approach to that in Duchin, Matsusaka, and Ozbas (2010). Similarly, SOX-compliant firms are defined as those with both a majority independent board and a fully independent audit committee. We estimate the main models from the paper using this alternative measure and find qualitatively similar results (in Online Appendix Table OA2).

6.2 Placebo test and the effect of SOX on less-confident managers

We conduct placebo tests to examine the effect of SOX on less confident managers. We do this by creating an indictor for whether the "Confidence(t)" measure is in the bottom quartile of all firms in that year, which we denote "ConfidenceBottomQ(t)." We then rerun the models by replacing the confidence measures with the *ConfidenceBottomQ(t)*. We also run tests in which we further exclude firms with confidence in the top quartile from the control sample. The results (unreported for brevity) indicate that SOX is not associated with a reduction in investment or risk taking, and is not associated with improvements in value, acquisition performance, earnings, or dividends for firms in the bottom quartile of confidence. In other words, the SOX effect observed for high-confidence managers is not observed for low-confidence managers.

6.3 Additional overconfidence measures and endogeneity issues

We take additional steps to mitigate endogeneity (reverse causality) concerns and examine alternative measures of overconfidence. However, we claim that endogeneity is not likely to be a major concern for several reasons. First, this potential source of endogeneity would actually bias *against* finding the results that we obtain. This is because the effect of overconfidence on corporate value is insignificant or negative, both in our results and in prior literature (see e.g., Malmendier and Tate 2005). Whereas, if endogeneity were an issue, one would expect a positive relationship between the CEO overconfidence measure and firm value. Second, the fact that we find strong changes in the effect of overconfidence on firm policy and value following an exogenous shock (SOX) indicates that the results are not being driven by endogeneity. Third, the additional finding that SOX did not influence the effect of overconfidence in compliant firms (see Section 6.1.1) lends further support to the direction of causality being from CEO overconfidence to value and other firm policies. Fourth, prior literature suggests that risk taking traits (including overconfidence) are personality attributes that tend to derive from genetic

characteristics (see, e.g., Cesarini, Johannesson, Lichtenstein, and Wallace 2009; Cronqvist, Münkel, and Siegel 2014; Cronqvist and Siegel 2014), and/or early life experiences (see e.g, Bernile, Bhagwat, and Rau 2014). Nonetheless, we undertake several additional analyses.

6.3.1 Media-based measure of overconfidence. The reverse-causality story largely pertains to the relationship between options and corporate outcomes. Such endogeneity is less likely to be a concern for the alternative press-based measure of overconfidence. Prior studies have used press-based measures of overconfidence, usually based on a comparison of the number of articles that report a CEO as being confident with those that report the CEO as being nonoverconfident (see e.g, Hirshleifer, Low, and Teoh 2012). We follow a similar method and construct a "Net News" measure, which is equal to the number of articles that report the CEO as confident less the number that report the CEO as nonoverconfident. We obtain news articles by conducting a Factiva keyword search of articles in the NYT, USA Today, BW, and the WSJ. We have these data for the years 2000, 2004, and 2006. We run the analysis between the years 2000 and 2006 and fill data for the years in which we are missing news articles. Specifically, if the firm lacks news data for year t then we use the data available from year $t-1$.[16] We require that the firm have at least one "confident" news item so that we avoid biasing the results by including firms with a dearth of coverage, to ensure that the sample focuses on "confident" CEOs, thereby making the sample comparable to that on which the confidence measure is based (which is what holding in the money options would imply), as well as to analyze how the extent of overconfidence influences the outcomes in question.[17] We report results for the main set of models in Online Appendix Table OA3. The important results are qualitatively similar to those obtained with option-based measures, indicating robustness of the results to alternative proxies for overconfidence.

6.3.2 Options relative to CEO compensation. A concern about some option-based overconfidence measures is that they do not capture whether the vested options are economically important to the CEO. One way to get at this is to divide the value of the options by the CEO's salary. We construct this measure by taking the natural log of one plus the ratio of the total value of vested but unexercised options scaled by the CEO's total compensation (Execucomp: tdc1). The results are in Online Appendix Table OA4 and are qualitatively similar to those in the main models.

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[16] The results are largely robust to using a backfilled measure (i.e., if the data are missing for year t, then using the data from year $t+1$), presumably on account of persistence in the confidence measures.

[17] Our results are qualitatively similar if we recode the missing "Net News" values as zero to deem the CEO to be nonoverconfident.

6.3.3 Other measures of overconfidence. Another concern is that the reported overconfidence measures are based on option prices, and thus are sensitive to the performance of the market. We argue that this is not likely to drive the results because the reported models also use the "ConfidenceTopQ(t)" indicator, which indicates whether the confidence measure is in the top quartile in year t. Given that this measure ranks firms within each year and that all firms are exposed to market forces, this variable helps to partially mitigate the concern that the results merely reflect changes in the value of options because of changes in market conditions. Nonetheless, in addition to the press-based measure of overconfidence, we ensure that the results are robust to several alternative definitions of overconfidence.

First, the results hold if we use cut offs other than the top quartile to identify the highly overconfident CEOs: that is, if we examine CEOs with confidence measures in the top 50% through to top 10%.

Second, we construct the aforementioned Holder67-type variable, which equals one if the CEO's confidence exceeds 67%. This reflects the technique that Malmendier, Tate, and Yan (2011) use to construct Holder67 using publicly available data. Such levels of confidence are associated with deep in-the-money options, for which an increase in risk will lead to only a minimal increase in option value. Thus, this set of CEOs is unlikely to engage in risk taking purely for the reason of increasing their option value. The results hold if we replace our confidence measures with this Holder67-type measure.

Third, the results hold if we construct dummy variables that equal one if the CEO's overconfidence measure, "ConfidenceTopQ" equaled one in any prior year, which we call "PriorTopQ." The interpretation of "PriorTopQ" is that it reflects overconfidence as a behavioral trait of the CEO. The results also hold if we use a variable "AnytimeTopQ" that equals one if the CEO's "ConfidenceTopQ" variable equals one in any year (either before or after the present year). This variable works on the assumption that overconfidence is a behavioral attribute that can manifest itself after the present year, even if the CEO does not currently appear to be overconfident. When using these results, we focus on models that include year fixed effects and industry fixed effects (rather than firm fixed effects) because of the firm-time-invariant nature of *AnytimeTopQ*.

Fourth, we address the possibility that the *Confidence* measure merely reflects private information about future performance.[18] We obtain a "residual" confidence measure (*Confidence Resid FR*), which is the residual from a regression of the *Confidence* variable onto stock returns from year $t+1$. This *Confidence Resid FR* represents the portion of *Confidence* that does not merely reflect future performance. The results (unreported) are robust to using this

[18] The approach in Kolasinski and Li (2013) is not ideal in our framework: their measure is premised on the CEO purchasing stock in their own company and losing money on that purchase. However, this presupposes that the company performs poorly, creating a mechanical relationship with many of our dependent variables.

alternative measure, suggesting that private information about future stock performance is unlikely to drive our results.

Further, the argument that CEOs rationally hold well-in-the-money options because of private information would suggest a fair degree of transience in the CEO's tendency to hold these options (i.e., he or she would hold them if and only if they have positive private information). Around 18% of the sample transitions to or from the top quartile in confidence in any given year. The results (unreported) are robust to dropping from the sample any observation where the CEO transitions from being highly overconfident (not overconfident) in year $t-1$ to being nonoverconfident (highly overconfident) in year t.

Fifth, to address the issue that the *Confidence* measure might merely be an artifact of prior performance, we estimate a *Confidence Resid LR* measure, which is the residual of a regression of *Confidence* onto the firm's lagged stock return (or stock market return). This measure represents the portion of *Confidence* that does not merely reflect prior stock performance. The results (unreported) are robust to using this *Confidence Resid LR* measure. Results are similarly robust when using a residual measure based on the news-based measure of overconfidence instead.

Sixth, the results are robust to using further lags of the overconfidence measure (in the reported results, the overconfidence measures date from year t, whereas the outcome measures date from year $t+1$).

Seventh, the results are also robust to using the natural log of the number of unexercised exercisable options (rather than their value), which would be arguably less subject to endogeneity concerns. Similarly, the results are robust to replacing the "Confidence" measure with the natural log of the total value of the CEO's unexercised, but exercisable, options.

6.4 Other robustness tests

6.4.1 Robustness to changes in sample composition. We take steps to mitigate possible concerns that the results could be affected by the sample composition and/or improvements in Execucomp's data. We do this by examining the subsample of observations for the 1998–2006 period for firms that are in the database for all of 1998–2006 (i.e., a sample that does not change over the tight window surrounding SOX). For these tests, the results (unreported) are qualitatively similar to the reported results.

6.4.2 CEO age and gender. One issue is that there may be a significant relationship between age and risk taking (see e.g., Kim 2013). The reported models control for CEO age. However, we also find that the results are qualitatively robust to splitting the sample based on median CEO age, suggesting that mere CEO age does not drive the results. The results are also robust to controlling for CEO-gender, which Levi, Li, and Zhang (2010) indicate is correlated with overconfident-like behavior, such as the tendency to undertake acquisitions.

6.4.3 Governance factors. We take steps to ensure that the confidence effect does not merely reflect corporate governance factors. Our main models control for CEO-level governance characteristics and institutional ownership, suggesting that governance characteristics do not explain the SOX-overconfidence relationship. The main models do not control for antitakeover provisions because requiring ATPs significantly reduces the sample size. Nonetheless, as indicated in Online Appendix Table OA5, our results are robust to controlling for managerial entrenchment. We obtain similar results if we control for both the state-average entrenchment-index as developed in Bebchuk, Cohen, and Ferrell (2009) and the firm-level entrenchment index.

6.4.4 Time from IPO. The results are robust to excluding companies that became public only recently. The concern is that CEOs in newly public firms often obtain options at the IPO issue price rather than the first-day-close price (see e.g., Lowry and Murphy 2007), allowing them to benefit from underpricing. This could lead to CEOs in some newly-public firms having deep in-the-money options, giving the appearance of overconfidence. It could be argued that the retention of such options would still connote overconfidence, because these CEOs would be rationally expected to exercise the deep in-the-money options, just as CEOs of established firms do. Nonetheless, the results (untabulated) are similar to the reported results.

6.4.5 Time effects and industry effect. In the reported models, we include two-digit SIC dummies and year dummies, or firm and year dummies. All models cluster standard errors by firm. The results are robust to including industry dummies at various SIC-digit levels (or none at all), to excluding year-dummies, or to clustering by industry or year instead of by firm. The results are also robust to using either NAICS 3-digit industries or Hoberg and Phillips (2010) industries. We also obtain qualitatively similar results if we cluster by year, industry, or double cluster by firm and year.

The results hold when we look at smaller windows around SOX in 2002 and restrict the sample to 1998–2004 or 1999–2003. The results are also qualitatively similar if we omit the tech-crash years of 2000 and 2001, or if we remove all high-tech firms from the sample.[19] The results are also robust to omitting the financial crisis years (2007 onward).

Another concern is that the purported effect of SOX could be affected by the response to back-dating scandals during this period. These backdating scandals tend to occur in firms with a higher proportion of inside directors (Veld and Wu 2014). We address this by using Corporate Library to identify firms with

[19] Specifically, we define high-tech firms, following Loughran and Ritter (2002), as those whose industries are in computer hardware (SIC: 3571, 3572, 3575, 3577, and 3578), communication equipment (SIC: 3661, 3663, 3669), electronics (SIC: 3671, 3672, 3674, 3675, 3677, 3678, 3679), and navigation (SIC: 3812), measuring (SIC: 3823, 3825, 3826, 3827, and 3829), medical (SIC 3841 and 3845), telecommunications equipment (SIC: 4812, 4813), communication services (SIC: 4899), software (SIC: 7371, 7372, 7373, 7374, 7375,7378 and 7379).

any backdating occurrences. The results (unreported) are robust to excluding these firms from the sample.

6.4.6 CEO turnover. The results are robust to excluding firms that experience a CEO changeover around SOX in 2002 (i.e., for whom the CEO in 2001 is different from the CEO in 2003). Thus, the results do not merely reflect a mechanical overconfidence change because of a change in CEO.

6.4.7 M&A and large loss deals. The M&A results are robust to controlling for the presence of "large-loss" and "large-gain" deals. Outlying large-loss deals can account for a significant portion of value destruction in acquisitions (see e.g, Moeller, Schlingemann, and Stulz 2004). Conversely, large-gain deals account for a significant portion of value creation in acquisitions (see e.g, Fich, Nguyen, and Officer 2012). We address the presence of such outlying deals by ensuring that the results (unreported) hold in quantile regressions (i.e., median regressions) and robust regressions and to omitting from the sample acquisitions where the "performance" variable (i.e., CAR, BHAR, Q, or EBIT/Assets, as applicable) is in the top 1% or bottom 1% of the sample.[20]

Overconfident CEOs tend to be more acquisitive, which could inflate goodwill and, hence, the value of assets for acquisitive versus nonacquisitive firms. This could potentially bias the results. We find that the results (unreported) are robust to subtracting goodwill from the firms' book assets for all variables that are based on assets, suggesting that the presence of goodwill does not qualitatively affect our results.

6.4.8 Modeling technique. The reported models are ordinarily OLS models with various combinations of fixed effects. Some of the dependent variables are bounded above zero and/or below one. We verify that the results are robust to using Tobit models with appropriate upper and lower bounds.

7. Conclusion

The literature suggests that CEO overconfidence can convey benefits, as well as costs. Even though CEO overconfidence is associated with innovation (see e.g, Hirshleifer, Low, and Teoh 2012), it is also associated with overinvestment and risk taking (see e.g, Malmendier and Tate 2005, 2008), potentially leading to increased CEO turnover as in Campbell and others (2014). We hypothesize that improving internal governance and disclosure can help to restrain overconfident CEOs. Thus, appropriate changes to governance and advisory structures could help capitalize on the optimism of overconfident CEOs to create shareholders value. The concurrent passage of SOX, though not usually attributed to CEO

[20] Note that all continuous variables are winsorized at 1%.

overconfidence, serves as a natural experiment to test whether increased oversight and exposure to diverse viewpoints from majority independent boards improves decision making by overconfident CEOs.

We find that SOX reduces overinvestment and risk taking by overconfident CEOs. Further, SOX enhances the effect of CEO overconfidence on firm value, earnings, EQ, the value of R&D, and the value of CAPEX. After SOX, overconfident CEOs' acquisitions create significantly more value (or at least destroy significantly less value). We also find evidence that SOX is associated with an increase in dividends by overconfident CEOs.

The paper provides novel evidence on the consequences of SOX: the ramifications appear to go well beyond limiting expropriation and perquisite consumption by powerful CEOs. Therefore, at least to a degree, the benefits may be an unintended consequence of the legislation: coming in the form of moderating the excesses of highly overconfident CEOs. In terms of policy, our findings may not extrapolate easily to other types of broad governance mandates that may have been proposed or enacted. Burdensome constraints on a firm's management could well be counterproductive by overly restricting overconfident CEOs. In the specific case of SOX and CEO overconfidence, however, the law appears to have imposed a beneficial restraint on the excesses of overconfident CEOs and to have enhanced shareholder wealth and social welfare.

Appendix

Table A1
Variable Definitions

Table A1 contains the variable definitions. All continuous variables are winsorized at 1% unless otherwise specified.

Variable	Definition
Overconfidence measures	
Confidence	A measure of how in-the-money the CEO's vested stock options are. First, we obtain the total value-per option of the ITM options by dividing the value of all unexercised exercisable options (Execucomp: opt_unex_exer_est_val) by the number of options (Execucomp: opt_unex_exer_num). Next we scale this 'value-per-option' by the price at the end of the fiscal year as reported in (Compustat: prcc_f).
SOX measure	
SOX	An indicator that equals one if the observation occurs in 2002 or later and equals zero otherwise.
Performance measures	
MTB	The firm's market-to-book ratio, being its market value at the end of the fiscal year (CRSP/Compustat: prcc_f × csho) divided by its book assets (Compustat: at).
Ind adj MTB	The firm's industry adjusted Tobin's Q, defined as its Tobin's Q less the average Tobin's Q for all firms in its two-digit SIC industry and year.
EBIT/assets	The firm's EBIT (Compustat: ebit) scaled by its book assets (Compustat: at).
Ind adj EBIT/assets	The firm's EBIT/assets less the mean EBIT/assets for all companies in the firm's two-digit SIC industry and year.

(continued)

Table A1
Variable Definitions—Continued

Variable	Definition
Risk measures	
Beta	The firm's beta as estimated using a single index model using daily stock returns over the course of the year with an CRSP equally weighted market index.
ln (variance)	The firm's daily stock price variance over the course of the year.
ln (MSE)	The mean squared error from the estimation of the single index model (above) over the course of that year.
Governance variables	
ln (CEO tenure)	The natural log of one plus the number of years that the CEO has been the CEO of the company.
ln (CEO age)	The natural log of the CEO's age.
CEO bonus/salary	The ratio of the CEO's bonus payment as ratio of his or her fixed salary.
CEO%ownership	The percentage of the firm that the CEO owns.
Inst%ownership	The percentage of the firm that institutional investors owns.
BCF	The Bebchuk, Cohen, and Ferrell (2009) entrenchment index; we use this in robustness tests in Table OA5. The data is from IRRC/Risk Metrics.
State ave BCF	The average Bebchuk, Cohen, and Ferrell (2009) entrenchment index for all companies in the subject-company's state and year. We use this in robustness tests in Table OA5 and the data are from IRRC/risk metrics.
Corporate variables	
Cash/assets	The firm's cash holdings (Compustat: ch) divided by its book assets (Compustat: at).
R&D/sales	The firm's R&D expenditure (Compustat: xrd) divided by its sales (Compustat: sale).
CAPEX/assets	The firm's capital expenditures (Compustat: capx) scaled by its assets (Compustat: at).
CAPEX/sales	The firm's capital expenditure (Compustat: capx) divided by its sales (Compustat: sale).
Ln (assets)	The natural log of the firm's book assets (Compustat: at).
Debt/assets	The firm's long-term debt (Compustat: dltt) scaled by its assets (Compustat: at).
Intangibles/ assets	The firm's intangible assets (Compustat: intan) scaled by its total book assets (Compustat: at).
Stock return	The firm's cumulative daily stock return over year t. The data is from CRSP.
Stock std dev	The firm's standard deviation of daily stock returns over year t. The data is from CRSP.
Prop No Trade Days	The proportion of days in year t on which there was no trade in the company's stock.
Acquisition Characteristics	
CAR(-5,5)	The acquirer's cumulative abnormal return from 5 days before the acquisition announcement to five days after the acquisition announcement; the cumulative abnormal return on day t is the firm's raw return less the return predicted by a market model; we obtain the market model parameters using an OLS estimation of the market model from 125 days before the acquisition announcement for a period of 250 days.
CAR(-42,126)	The acquirer's cumulative abnormal return over the period 42 days before the acquisition announcement to 126 days after the acquisition announcement; the cumulative abnormal return on day t is the firm's raw return less the return predicted by a market model; we obtain the market model parameters using an OLS estimation of the market model from 125 days before the acquisition announcement for a period of 250 days.
BHAR(-5,250)	The buy-and-hold abnormal return earned from holding the acquirer's stock from 5 days before the acquisition announcement to 250 days after the acquisition announcement; the abnormal returns are based on a market model with parameters estimated using OLS from 11 days to 210 days before the acquisition announcement.
Diversifying deal	A dummy variable that equals one if the bidder and target are in different SIC two-digit industries and equals zero otherwise.

(continued)

Table A1
Variable Definitions—Continued

Variable	Definition
Acquisition Characteristics—Continued	
Run up	The acquirer's cumulative abnormal return earned over the period 260 days to 11 days before the acquisition announcement.
Competed deal	A dummy variable that equals one if there is more than one bidder and equals zero otherwise.
Tender offer	A dummy variable that equals one if the deal was a tender offer and equals zero otherwise.
Tender offer	A dummy variable that equals one if the target is publicly listed and equals zero otherwise.
Cash only	A dummy variable that equals one if the method of payment was 100% cash and equals zero otherwise.
Rel deal size	The ratio of the target's market capitalization scaled by the acquirers assets.
ln(transaction value)	The natural log of the deal value.

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