CEO personality traits, strategic flexibility, and firm dynamics

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A R T I C L E   I N F O

A B S T R A C T

Reexamining CEO personality traits from a real options theory perspective, we suggest that the firm's strategic flexibility can be worsened by CEO conscientiousness and neuroticism. We use a measure of strategic flexibility as the firm's ability to take advantage of heightened volatility, which then results in superior stock returns. Our results suggest that strategic adaptability is impeded by rigid planning, resistance to change (conscientiousness) and lack of emotional stability (neuroticism). For firms that experience a decrease in volatility, the opposite holds. In line with trait activation theory, our results imply that the effect of specific CEO personality traits on firm dynamics and performance is contingent and context-specific. Our findings are economically significant and have important implications concerning CEO selection and management.

> "*The only constant is change*"
> Heraclitus, Greek philosopher

1. Introduction

Strategic flexibility is critically important when firms face significant changes in their environment (Nadkarni and Narayanan, 2007). Firm-level characteristics can help explain which firms prosper in periods of heightened volatility ("stormy waters") and which firms do so in more stable periods ("calm waters"). Grullon et al. (2012) find that firms with growth opportunities (small, young, research-intensive, fast-growing firms) and high operational flexibility (non-unionized, high earnings or sales convexity) prosper in times of increased volatility but firms with the opposite characteristics thrive in more stable periods. Yet, firms are run by CEOs (captains of the firm ship) and so CEOs do matter (Hambrick and Mason, 1984; Bertrand and Schoar, 2003). CEO personality traits are

the subjective lenses through which CEOs view strategic situations, take important initiatives, and decide on responses to changes in their firm's business environment (Nadkarni and Herrmann, 2010). Thus, we ask the question: Which CEO personality traits are best for navigating the firm ship through stormy waters (versus calm waters)?

We thereby extend existing literature and show that, beyond firm characteristics, CEO personality traits also matter for the firm's ability to steer through periods of heightened volatility. We use the Big Five personality trait framework (Tupes and Christal, 1961; Norman, 1963) to investigate CEO personality traits for non-financial S&P 1500 firms from ExecuComp in a 12-year period, from 2007 to 2018. The Big Five personality traits consist of Openness to experience, Conscientiousness, Extraversion, Agreeableness, and Neuroticism (OCEAN). OCEAN is the most established personality traits framework in the psychology literature and has been shown to be relevant to the leader trait perspective (Judge et al., 2002).

We measure the degree of strategic flexibility by examining the firm's ability to take advantage of heightened volatility, which ultimately results in superior stock returns. Our results show that the firm's strategic flexibility is worsened by CEO conscientiousness and neuroticism. Conscientious CEOs tend to be efficient, organized, goal-directed, and adhere to norms. Such qualities, however, can be disadvantageous in environments of change when volatility increases considerably, as rigid planning becomes obsolete. Neurotic CEOs also have a hard time coping with adverse conditions and increased volatility.

Our results are not only meaningful but are economically significant: a one standard deviation change in volatility coupled with increases from the 25th to the 75th percentile in CEO conscientiousness and CEO neuroticism translate into reductions in excess monthly stock returns in the range of 30 basis points (corresponding to 3.6% lower annual return) after controlling for conventional risk factors. Thus, CEOs who are conscientious and neurotic are detrimental for firm performance during times of increased volatility. However, such CEO personalities fare better during times of decreased volatility. In line with extant literature (Judge et al., 2009; Morgeson et al., 2007; Nguyen et al., 2018; Hutton et al., 2015), we do not find that specific Big Five personality traits are generally value enhancing. Amazon CEO Jeff Bezos is an exemplification of a CEO who is superior in exploiting high volatility. Jeff Bezos is marginally less conscientious and considerably less neurotic than his peers.[1] Amazon has managed to preserve agility on a base of stability in the form of signature processes around synchronized supply chains (Aghina et al., 2015).

Our main model follows Grullon et al. (2012) that utilize the Fama and MacBeth (1973) rolling regression approach. Our results are robust to panel regressions with standard errors adjusted to clustering at the firm level (Petersen, 2009) as well as to structural equation modeling. The results remain the same in alternative samples.

Our contribution to existing literature is twofold. *First*, our findings contribute to the strategic flexibility and real option literature by highlighting that not only firm characteristics but also CEO characteristics (specifically, CEO personality traits) matter for the firm's ability to navigate in stormy versus calm waters. The firm's ability to be proactive and respond swiftly to changing conditions – known as strategic flexibility (Sanchez, 1995; Volberda, 1996) – depends on the personality of the captain of the firm ship. We extend the reasoning of Driouchi et al. (2022) who posit that managerial and behavioral attributes are key to the visualization and exercise of growth opportunities. The authors argue that the real options literature has yet to incorporate aspects of managerial ability and skills into the real options value equation. Trigeorgis and Reuer (2017) also highlight that novel research opportunities exist to realize real option theory's potential through better integration with behavioral perspectives. Herhausen et al. (2021) also note that there is a dearth of literature on the interaction between individual-level phenomena regarding C-suite executives and strategic flexibility. We address this gap in the literature by investigating the corporate value implications of the interaction between CEOs' personality traits and the firm's ability to cope with increased volatility through the exercise of real options. *Second*, our findings more generally contribute to the trait activation literature (Tett and Burnett, 2003; Judge and Zapata, 2015) by showing that specific CEO personality traits manifest themselves not through a general ability to outperform but through a specific ability to outperform or underperform in specific contexts. In this sense, our findings also contribute to the ongoing debate about when and how much CEOs really matter (Fitza, 2014, 2017; Quigley and Graffin, 2017).

Our paper proceeds as follows. We next review the literature and develop our hypotheses. We then describe our sample and the variables used in the empirical analysis, followed by our empirical results. Finally, we conclude and discuss the practical implications of our findings.

2. Literature review and development of hypotheses

In this section, we review the extant literature on firms' ability to exploit volatility via strategic flexibility and real options. We also review the literature on the Big Five personality traits and develop our hypotheses.

2.1. Exploiting volatility via strategic flexibility

In a corporate setting facing heightened uncertainty, managers must prepare their firms for and react to environmental changes through strategic flexibility (Hitt et al., 1998) and dynamic capabilities (Wang et al., 2015). Strategic flexibility is the firm's ability to adapt to substantial, uncertain, and fast-occurring environmental changes that have a meaningful impact on firm performance (Aaker and Mascarenhas, 1984) – put more simply, an expedient capability for managing capricious settings (Evans, 1991). Trigeorgis (1993) provides examples of real options, such as the ability to defer, expand, contract, abandon, or otherwise alter a project. According to real

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[1] Jeff Bezos scores 5.04 on conscientiousness and 2.47 on neuroticism. The corresponding mean values for our CEOs of non-financial S&P 1500 firms are 5.09 and 3.27, respectively (Table 1).

option theory (Dixit and Pindyck, 1994; Trigeorgis, 1996), managers exploit such strategic flexibility when the business environment changes signaling that the prospects of a project have changed compared to initial expectations or assumptions. Of course, in some circumstances firms may prefer less flexible arrangements to capture the economic benefits of commitment (Barnett, 2003; Brunsson, 1990; Dalziel, 2009) especially when flexibility is already achieved through other means such as strategic options generated by past activity (Brouthers et al., 2008; Brouthers and Dikova, 2010).

Various managerial constraints may impede management's timely response to changes in the business environment. Such constraints include bounded rationality (Simon, 1955) and, more broadly, managerial biases and personality traits (Svenson, 1981; Graham et al., 2013; Brunell et al., 2008; Maccoby, 2000; Green et al., 2019). Nadkarni and Herrmann (2010) argue that the psychological attributes of CEOs act as subjective lenses through which CEOs view strategic situations and decide on responses, shaping their fields of vision, their selective perception, and their interpretation of perceived cues.

Duffee (1995) finds a positive relation between firm stock return volatility and stock returns. Grullon et al. (2012) argue that this positive relation exists because firms can change their operating and investment decisions to mitigate the effect of bad news and amplify the effect of good news (an inherent asymmetry). They show that firms with abundant investment opportunities (small firms, young firms, R&D firms, and high growth firms) and high operational flexibility (firms in non-unionized industries and firms with high earnings or high sales convexity) exhibit a stronger positive relationship between firm stock returns and changes in stock volatility than other firms. Aabo et al. (2016) extend this work showing that the firm's multinationality also acts as a real option facilitator. The findings of Grullon et al. (2012) are in line with Nadkarni and Herrmann (2010) who find that younger firms are more flexible. Herhausen et al. (2021) also find in a meta-analysis that environmental dynamism positively moderates the relationship between strategic flexibility and performance. However, they find no indication that firm size or age inhibit strategic flexibility. The literature on the value of strategic flexibility generally recognizes that flexibility is not without costs and that it is beneficial in dynamic environments but not in stable environments (e.g., Claussen et al., 2018), in line with Grullon et al. (2012) and Herhausen et al. (2021). We contribute to the existing research by shedding light on CEO characteristics (more specifically, CEO personality traits) as opposed to firm-level characteristics.

2.2. CEO personality traits and development of hypotheses

Tupes and Christal (1961) and Norman (1963) introduced the five-factor model of personality traits. The Big Five personality traits are (1) Openness to experience, (2) Conscientiousness, (3) Extraversion, (4) Agreeableness, and (5) Neuroticism, in short, OCEAN. Costa Jr. and McCrae (1988) and Digman (1989) further showed that the Big Five personality traits are heritable and fairly stable over time. The OCEAN framework is the most established in the psychology literature and is relevant to the leader trait perspective (Judge et al., 2002).

Openness to experience is the disposition to be imaginative, nonconforming, unconventional, and autonomous (Judge et al., 2002). Bono and Judge (2004) find that open individuals score highly on the intellectual stimulation and inspirational motivation components of transformational leadership, as these leaders have a vivid imagination, are able to challenge conventional wisdom on critical issues, and visualize a compelling future for the organization. Openness to experience is positively related to creativity and divergent thinking (McCrae, 1987) and leads to creative expression and exploration (King et al., 1996). Thus, persons who are open to experience tend to engage actively and flexibly with novel situations (DeYoung et al., 2005). Datta et al. (2003) find that CEO openness to change is important for strategic adaptation in dynamic environments. Therefore, we expect that CEOs who are more open to experience should be better able to capitalize on strategic flexibility by exploiting heightened volatility and see opportunities where others see only threats.

Hypothesis 1. CEO's openness to experience improves the firm's strategic flexibility.

Conscientiousness is positively related to acting responsibly, with reliability and dependability (Costa Jr. and McCrae, 1992). Conscientious managers tend to be well-organized and methodical (Jackson et al., 2010) and exhibit tenacity and persistence in pursuit of organizational objectives (Goldberg, 1990). They strive for achievement (Costa Jr. and McCrae, 1992) and are ambitious (Goldberg, 1990). They set specific work goals for themselves and are committed to these goals (Barrick et al., 1993). Highly conscientious individuals tend to be cautious and analytical, and therefore less willing to innovate or take risks (Judge et al., 2009). However, dependability involves considerable concern for legalism and commitment to established rules (Peterson et al., 2003). Managers with high dependability avoid taking actions that deviate significantly from past experience (Nadkarni and Herrmann, 2010). They have a narrower field of vision which impedes their ability to react to uncertain environments through the exercise of strategic options (Johnson et al., 2003). Thus, we expect conscientious CEOs to struggle with exploiting firm flexibility in an environment of increasing volatility.

Hypothesis 2. CEO conscientiousness limits the firm's strategic flexibility.

Extraversion is the tendency to be sociable, assertive, active, and experience positive effects such as energy and zeal (Judge et al., 2002). Extraversion is positively related to social and interpersonal skills (Graziano and Eisenberg, 1997). Extraverts are more likely to engage in social behavior and enjoy social attention than introverts (Ashton et al., 2002). They view social encounters to be more positive (Graziano et al., 1985) and they are skilled at handling problems requiring social interaction (Tett and Burnett, 2003). Many extraverts are high-energy excitement seekers (Costa Jr. and McCrae, 1992) and excel in competitive environments (Bentea and Anghelache, 2012). The sociability of extraverted CEOs allows them to develop extensive social networks within and outside their firms (Nadkarni and Herrmann, 2010). Thus, we expect that more extraverted CEOs should be better suited to take advantage of

enhanced volatility due to their wider social network that provides them with early information and better ability to leverage their social skills in changing circumstances.

Hypothesis 3. CEO extraversion improves the firm's strategic flexibility.

Agreeableness is the tendency to be trusting, compliant, caring, and gentle (Judge et al., 2002). Agreeableness is positively related to warmth, trust, kindness, cooperativeness, and modesty (Costa Jr. and McCrae, 1992). Agreeable managers maintain positive interpersonal relationships with others (Barrick et al., 2002) and are more eager to cooperate and avoid conflict (Goldberg, 1990; McCrae and Costa Jr., 1990). Nadkarni and Herrmann (2010) argue that the altruistic tendency of CEOs high in agreeableness may promote passivity and compliance and shift focus away from the achievement of important task goals. Agreeable CEOs with a non-confrontational style may be better suited for positions that demand adherence to the status quo but are unlikely to support radical process innovations or changes in organizational policies (Judge et al., 2009). Thus, we expect that more agreeable CEOs should be less well suited to take advantage of heightened volatility because their desire to be a "good guy" would mitigate their ability to take necessary (and often harsh) decisions in stormy waters.

Hypothesis 4. CEO agreeableness limits the firm's strategic flexibility.

Neuroticism represents a tendency to exhibit poor emotional adjustment and experience negative effects, such as anxiety, insecurity, and hostility (Judge et al., 2002). Neuroticism is an affective trait (Costa Jr. and McCrae, 1980) and is positively associated with susceptibility to negative effects and lack of emotional control (Riggio, 1986). Neurotic persons often rely on withdrawal and wishful thinking as coping strategies (Connor-Smith and Flachsbart, 2007). They are unable to remain calm and balanced in stressful situations (Peterson et al., 2003). The lack of adaptability of emotionally unstable CEOs makes them more reluctant to change and impedes their ability to generate appropriate responses to change (Nadkarni and Herrmann, 2010). Thus, we expect that more neurotic CEOs should struggle with increases in volatility due to their inability to stay calm in stormy waters.

Hypothesis 5. CEO neuroticism worsens the firm's strategic flexibility.

3. Data, variables, and regression model

In this section, we describe 1) our sample, 2) our volatility measure, and 3) the CEO Big Five personality trait measures. We also present our regression model.

3.1. Data sources and sample selection

Our sample contains 893 S&P 1500 firms per mid-2019 with information in ExecuComp for the fiscal years from 2007 to 2018. We

Table 1
Descriptive statistics.

	N	Mean	Standard deviation	5th percentile	25th percentile	Median	75th percentile	95th percentile
Firm characteristics								
Excess monthly return	110,240	0.010	0.112	−0.161	−0.048	0.010	0.065	0.178
Market factor loading	110,240	1.195	0.684	0.213	0.774	1.121	1.545	2.444
Book-to-market ratio	110,240	0.357	0.191	0.092	0.221	0.329	0.466	0.719
Size	110,240	21.807	1.572	19.486	20.646	21.624	22.872	24.747
Leverage	110,240	0.210	0.168	0.000	0.058	0.200	0.319	0.511
Previous return	110,240	0.073	0.263	−0.347	−0.082	0.064	0.211	0.524
Dividend payout	110,240	0.218	0.465	0.000	0.000	0.079	0.334	0.898
Capital expenditures	110,240	0.081	0.397	0.006	0.019	0.032	0.057	0.243
Volume	110,240	0.225	0.171	0.062	0.115	0.176	0.277	0.566
ΔVolatility	110,240	0.000	0.015	−0.023	−0.005	0.000	0.005	0.024
CEO characteristics								
CEO age	110,240	4.039	0.118	3.829	3.951	4.043	4.127	4.220
CEO tenure	110,240	1.821	0.856	0.000	1.099	1.946	2.485	3.178
CEO gender	110,240	0.031	0.174	0.000	0.000	0.000	0.000	0.000
CEO duality	110,240	0.422	0.494	0.000	0.000	0.000	1.000	1.000
CEO education	110,240	0.417	0.493	0.000	0.000	0.000	1.000	1.000
CEO salary and bonus	110,240	0.252	0.208	0.066	0.118	0.182	0.306	0.761
CEO incentives	110,240	2.593	4.447	0.000	0.519	1.239	2.734	9.444
CEO personality traits and biases								
CEO openness	110,240	4.660	0.554	3.700	4.240	4.710	5.070	5.520
CEO conscientiousness	110,240	5.087	0.490	4.310	4.740	5.050	5.420	5.960
CEO extraversion	110,240	4.744	0.812	3.020	4.350	4.880	5.270	5.880
CEO agreeableness	110,240	4.076	0.784	2.680	3.520	4.110	4.640	5.290
CEO neuroticism	110,240	3.265	0.609	2.290	2.910	3.230	3.610	4.350
CEO narcissism	110,240	0.237	0.077	0.120	0.180	0.230	0.290	0.370
CEO overconfidence	110,240	0.454	0.498	0.000	0.000	0.000	1.000	1.000

All continuous variables are winsorized at the upper and lower 1 percentiles of the sample distribution.
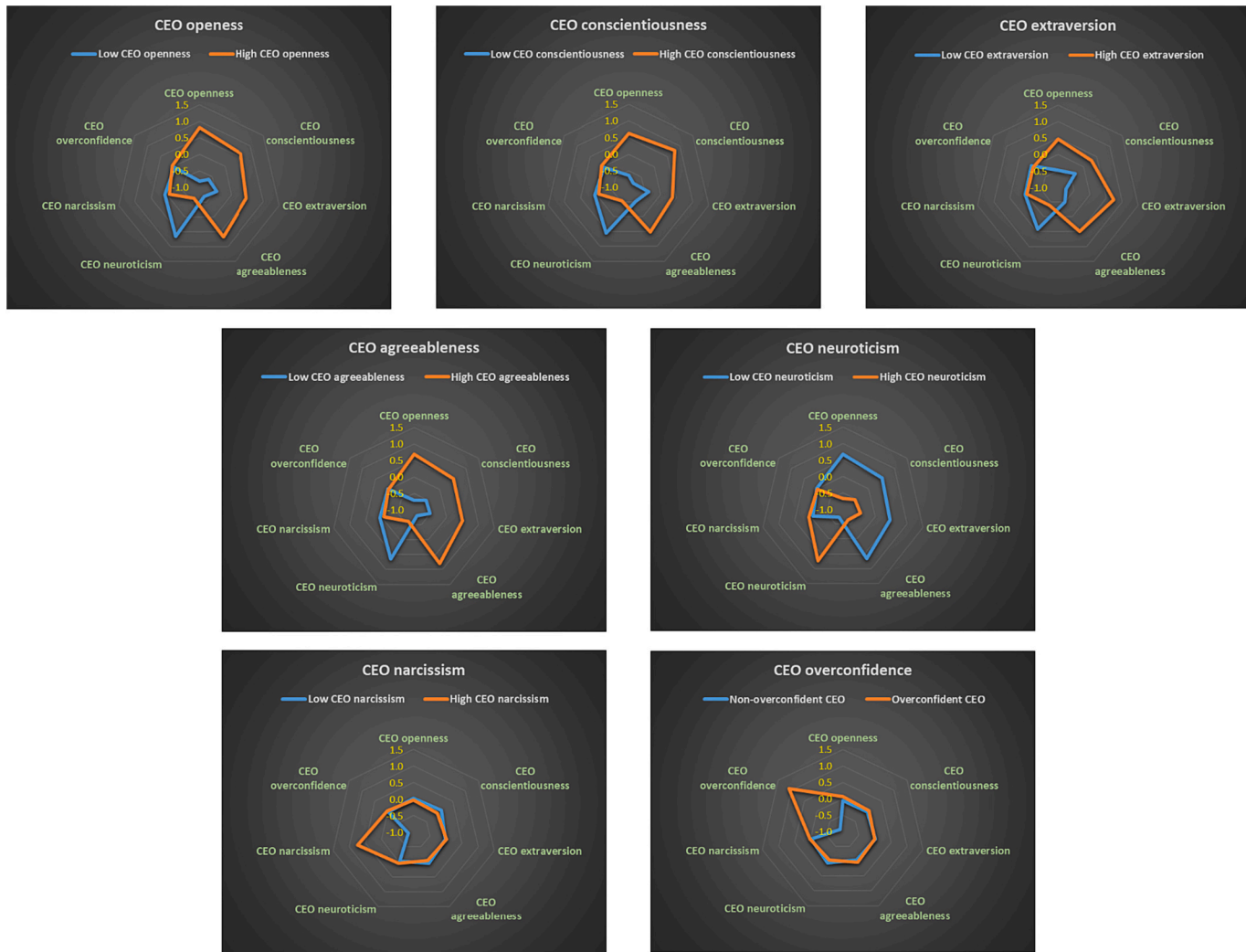
Fig. 1. Radar charts of CEO personality traits and biases.
This figure plots the standardized values of CEO personality traits and biases.

Table 2
Pairwise correlations.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Excess monthly return	1.000											
(2) Market factor loading	0.037	1.000										
	[0.000]											
(3) Book-to-market ratio	0.034	0.176	1.000									
	[0.000]	[0.000]										
(4) Size	−0.035	−0.193	−0.374	1.000								
	[0.000]	[0.000]	[0.000]									
(5) Leverage	−0.006	0.004	−0.030	0.207	1.000							
	[0.045]	[0.173]	[0.000]	[0.000]								
(6) Previous return	−0.023	0.023	−0.035	−0.023	−0.018	1.000						
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]							
(7) Dividend payout	−0.004	−0.097	−0.128	0.155	0.082	−0.003	1.000					
	[0.146]	[0.000]	[0.000]	[0.000]	[0.000]	[0.259]						
(8) Capital expenditures	0.001	0.051	0.038	0.011	0.051	−0.013	−0.034	1.000				
	[0.837]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]					
(9) Volume	−0.048	0.152	0.084	−0.020	0.070	−0.064	−0.118	0.094	1.000			
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]				
(10) ΔVolatility	−0.090	0.081	−0.026	0.012	−0.004	0.065	0.004	0.001	0.118	1.000		
	[0.000]	[0.000]	[0.000]	[0.000]	[0.244]	[0.000]	[0.222]	[0.860]	[0.000]			
(11) CEO age	−0.003	−0.008	0.050	0.092	0.065	−0.006	0.058	−0.010	−0.063	0.002	1.000	
	[0.382]	[0.010]	[0.000]	[0.000]	[0.000]	[0.061]	[0.000]	[0.001]	[0.000]	[0.431]		
(12) CEO tenure	0.010	0.027	−0.016	−0.089	−0.057	0.024	−0.024	0.008	−0.030	−0.001	0.359	1.000
	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.006]	[0.797]	[0.000]		
(13) CEO gender	−0.002	−0.025	−0.002	0.040	−0.001	−0.001	0.044	−0.017	0.007	0.001	−0.032	−0.085
	[0.597]	[0.000]	[0.579]	[0.000]	[0.643]	[0.757]	[0.000]	[0.000]	[0.020]	[0.743]	[0.000]	[0.000]
(14) CEO duality	0.007	−0.029	−0.045	0.074	−0.018	0.005	−0.001	−0.028	−0.041	−0.002	0.032	0.105
	[0.019]	[0.000]	[0.000]	[0.000]	[0.000]	[0.086]	[0.817]	[0.000]	[0.000]	[0.425]	[0.000]	[0.000]
(15) CEO education	−0.001	−0.035	−0.035	0.174	0.032	−0.003	0.066	−0.015	−0.040	0.000	0.244	0.297
	[0.756]	[0.000]	[0.000]	[0.000]	[0.000]	[0.263]	[0.000]	[0.000]	[0.000]	[0.983]	[0.000]	[0.000]
(16) CEO salary and bonus	−0.011	0.039	0.151	−0.421	−0.157	−0.061	−0.031	0.002	−0.075	−0.006	0.013	0.137
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.502]	[0.000]	[0.061]	[0.000]	[0.000]
(17) CEO incentives	0.051	−0.040	−0.212	0.146	−0.052	0.117	−0.046	−0.010	−0.018	−0.002	0.015	0.192
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.002]	[0.000]	[0.422]	[0.000]	[0.000]
(18) CEO openness	0.009	−0.172	−0.261	0.087	−0.111	0.018	0.008	−0.137	−0.032	−0.001	−0.184	−0.026
	[0.002]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.007]	[0.000]	[0.000]	[0.678]	[0.000]	[0.000]
(19) CEO conscientiousness	0.003	−0.201	−0.227	0.107	−0.038	0.002	0.061	−0.081	−0.003	−0.001	−0.075	−0.080
	[0.403]	[0.000]	[0.000]	[0.000]	[0.000]	[0.424]	[0.000]	[0.000]	[0.260]	[0.731]	[0.000]	[0.000]
(20) CEO extraversion	0.008	−0.145	−0.242	0.139	−0.033	0.018	0.073	−0.212	−0.171	0.000	−0.217	−0.098
	[0.006]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.910]	[0.000]	[0.000]
(21) CEO agreeableness	0.010	−0.146	−0.277	0.103	−0.166	0.023	−0.008	−0.127	−0.074	0.000	−0.203	−0.068
	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.007]	[0.000]	[0.000]	[0.948]	[0.000]	[0.000]
(22) CEO neuroticism	−0.013	0.150]	0.284	−0.056	0.153	−0.025	−0.025	0.142	0.054	0.001	0.122	0.021
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.733]	[0.000]	[0.000]
(23) CEO narcissism	−0.001	0.001	0.015	0.050	0.011	−0.009	−0.003	−0.027	0.006	−0.002	0.068	0.074
	[0.651]	[0.780]	[0.000]	[0.000]	[0.000]	[0.000]	[0.299]	[0.000]	[0.065]	[0.603]	[0.000]	[0.000]
(24) CEO overconfidence	0.022	0.003	−0.156	0.058	−0.012	0.062	−0.073	0.021	0.030	0.001	0.115	0.379
	[0.000]	[0.325]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.635]	[0.000]	[0.000]

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
(13) CEO gender	−0.006	1.000										
	[0.048]											
(14) CEO duality	−0.022	0.041	1.000									
	[0.000]	[0.000]										
(15) CEO incentives	−0.041	−0.093	−0.047	1.000								
	[0.000]	[0.000]	[0.000]									
(16) CEO similarity	−0.034	0.086	0.063	0.065	1.000							
	[0.000]	[0.000]	[0.000]	[0.000]								
(17) CEO openness	0.060	0.038	−0.090	−0.069	0.110	1.000						
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]							
(18) CEO conscientiousness	0.149	−0.007	−0.012	−0.049	0.056	0.749	1.000					
	[0.000]	[0.014]	[0.000]	[0.000]	[0.000]	[0.000]						
(19) CEO extraversion	0.019	0.100	−0.069	−0.102	0.067	0.646	0.421	1.000				
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]					
(20) CEO agreeableness	0.064	0.097	−0.132	−0.101	0.124	0.843	0.609	0.645	1.000			
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]				
(21) CEO neuroticism	−0.081	−0.065	0.086	0.044	−0.112	−0.820	−0.657	−0.598	−0.805	1.000		
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]			
(22) CEO narcissism	−0.049	0.037	0.069	0.033	0.001	−0.046	−0.079	−0.013	−0.068	0.064	1.000	
	[0.000]	[0.000]	[0.000]	[0.000]	[0.873]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]		
(23) CEO overconfidence	−0.021	0.066	0.153	−0.047	0.294	0.057	0.032	−0.015	0.031	−0.045	0.019	1.000
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	

p-values are reported in brackets.

exclude SIC codes beginning with 6 (Finance, Insurance, and Real Estate) and 49 (Electric, Gas, and Sanitary Services) together with non-classified firms. We require information on CEO personality traits (and overconfidence). We exclude small firms (with a market cap of less than 100 million US$) in our main analysis but show that our conclusions are robust to their inclusion. In CEO numbers, we exclude interim CEOs who serve for less than 12 months. The tenures of these interim CEOs are divided between the previous CEO and/ or the following CEO. Thus, in our main analysis, we investigate 1654 CEOs from 846 S&P 1500 firms (110,240 firm-month observations).

3.2. Dependent variable

To examine our hypotheses whether CEO personality traits affect the strategic flexibility of firms, we follow Grullon et al. (2012) and use Fama and MacBeth (1973) cross-sectional rolling regressions where the dependent variable is excess monthly stock return ($r_{i,y,m} - r_{f,y,m}$). $r_{i,y,m}$ is stock return in month m of year y for firm i and $r_{f,y,m}$ is the risk-free rate of return in the same month.

3.3. Key explanatory variables

Change in volatility. We calculate the monthly volatility of a firm's assets in the following manner. First, we determine the volatility of the firm's equity by computing the standard deviation of its daily stock returns throughout the given month. To estimate the volatility of the firm's assets, we adopt a methodology based on the Merton (1974) distance-to-default model that views equity as a call option on the firm's assets with exercise price the face value of the debt, which is commonly used in the literature on KMV distance-to-default measurement (e.g., Bharath and Shumway, 2008). This approach involves simultaneously solving two equations: one that links the equity value to the value of the firm's assets and another that connects the volatility of the firm's equity to that of its assets. Our change in the asset volatility (*ΔVolatility*) measure is then obtained as the difference between the firm's asset volatility for the current month and that of the previous month.

Big Five personality traits. We follow Harrison et al. (2019, 2020) in measuring the Big Five personality traits for our sample of CEOs. Thus, we use transcripts of CEO speech in the Q&A sessions of quarterly earnings conference calls. Malhotra et al. (2018) note that the unscripted (unedited) Q&A section is more likely to reveal the true personality of the CEO. Green et al. (2019) also use the Q&A sessions of earnings conference calls. We restrict our sample of CEOs to those where we have at least three quarterly earnings conference calls and at least 1000 spoken words (Green et al., 2019; Malhotra et al., 2018; Harrison et al., 2019). Our default is to use four quarterly earnings conference calls (one for each quarter and spread across the tenure of the CEO).

Each personality trait score is a continuous score between 1 (e.g., extremely closed to experience) and 7 (e.g., extremely open to experience). We treat CEO personality traits as constant (not time-varying) variables, in line with the basic reasoning on personality traits in the psychology literature (McCrae and Costa Jr., 1994; Vernon et al., 2008; Miller and Campbell, 2010).

CEO narcissism and overconfidence. We include CEO narcissism and overconfidence as control variables for two reasons: (1) to help mitigate omitted variable bias, and (2) because both CEO narcissism (a personality trait) and CEO overconfidence (a cognitive bias) have received considerable attention in the literature (Chatterjee and Hambrick, 2007, 2011; Aktas et al., 2016; Ham et al., 2018; Malmendier and Tate, 2005; Campbell et al., 2011; Hirshleifer et al., 2012).

We measure CEO narcissism by the CEO's usage of first-person singular pronouns (FSP), in line with Chatterjee and Hambrick (2007) and Aktas et al. (2016). The FSP score is a continuous score between 0 (extremely non-narcissistic) and 1 (extremely narcissistic). We use an option-based measure (unexercised portion of exercisable in-the-money executive options) for CEO overconfidence in line with Malmendier and Tate (2005) and Campbell et al. (2011) as common in the literature (e.g., Galasso and Simcoe, 2011; Hirshleifer et al., 2012; Schrand and Zechman, 2012; Chen et al., 2015; Humphery-Jenner et al., 2016). We apply the standard cutoff rate of 67% in-the-money for unexercised exercisable options as a measure of overconfidence. The overconfidence variable is a dummy with value 1 for overconfident and 0 for non-overconfident CEOs.

3.4. Control variables

The first set of control variables include firm characteristics. *Market factor loading* is the estimated coefficient (beta) on daily market premiums for each month in the following market model.

$$r_{i,y,m,d} - r_{f,y,m,d} = \alpha + F\left(r_{market,y,m,d} - r_{f,y,m,d}\right) + \varepsilon_{i,y,m,d}, \tag{1}$$

where $F_{i,y,m}$ represents the market factor loading estimated on the daily information in month m. $r_{i,y,m,d}$ is firm i's return on day d in month m and year y, $r_{f,y,m,d}$ is the daily risk-free interest rate, and $r_{market,y,m,d}$ is the daily return on the value-weighted market portfolio. *Size* is the natural log of one plus total equity. *Book-to-market ratio* is the natural log of the ratio of book-value to market-value of equity. *Leverage* is the ratio of total debt to total assets. *Previous return* is 6-month lagged return from month m-6 to m-1. *Dividend payout* is the ratio of common and preferred dividends to net income. *Capital expenditures* is the ratio of capital expenditures to sales. *Volume* is the contemporaneous trading volume in month m adjusted by the number of common shares.

The second set of control variables include CEO characteristics. *CEO age* is the natural log of one plus CEO age. *CEO tenure* is the natural log of one plus the number of years the CEO has held the CEO position. *CEO gender* is an indicator that takes the value of 1 if the CEO is female and 0 otherwise. *CEO education* is an indicator equal to 1 if the CEO has a master's or doctoral degree and 0 otherwise. *CEO duality* is an indicator that takes the value of 1 if the CEO serves as the board chairman and 0 otherwise. *CEO salary and bonus* is the

sum of salary and bonus, scaled by total compensation. *CEO incentives* is the ratio of unexercised options (exercisable + unexercisable) and restricted stock holdings to total compensation.

3.5. Regression model

Our main regression model is based on the approach of Grullon et al. (2012), as follows:

$$r_{i,y,m} - r_{f,y,m} = \alpha + \sum \beta Firm_{i,y,m} + \beta \Delta Volatility_{i,y,m} + \sum \beta CEO_{i,y,m} + \sum \beta Trait_{i,y,m}$$

$$+ \sum \beta \Delta Volatility_{i,y,m}^{*} Trait_{i,y,m} + \varepsilon_{i,y,m}, \tag{2}$$

where the dependent variable ($r_{i,y,m} - r_{f,y,m}$) denotes excess stock return in month m of year y for firm i (above the risk-free rate of return in the same month). *Trait* includes the trait and bias variables of the CEO. The key explanatory variables are *ΔVolatility*, CEO trait variables, and their interaction terms. We control for firm variables (*Firm*) and CEO characteristics (*CEO*).

The coefficient of *ΔVolatility* captures the degree of firm's strategic flexibility to take advantage of heightened volatility. This approach has been recently used in management studies (e.g., Lee et al., 2018). To test whether CEO personality traits improve or worsen the firm's strategic flexibility (Hypothesis 1 to Hypothesis 5), we examine the coefficients of *ΔVolatility*Trait*.

4. Results

4.1. Descriptive statistics and correlations

Table 1 reports descriptive statistics for the main variables in our analysis. We refer to the Appendix for detailed descriptions of the variables. Table 1 shows that our sample CEOs tend to be *above* the midpoint in terms of openness to experience, conscientiousness and extraversion, *at* the midpoint in terms of agreeableness, and *below* the midpoint in terms of neuroticism. The results are in line with Harrison et al. (2019). Narcissism has a mean of 0.24, in line with Aktas et al. (2016) and Chatterjee and Hambrick (2007). About 45% of our sample CEOs are overconfident, a bit lower than in Hirshleifer et al. (2012) and Humphery-Jenner et al. (2016) who investigate earlier periods when more of CEO compensation was in the form of stock options (Hayes et al., 2012).

To elaborate on the correlations between CEO personality traits and biases, we plot the values on radar charts and standardize the values in Fig. 1. Because the values of CEO personality traits and biases are on different scales, we standardize these values. In each month, the standard deviation and mean value of each of CEO traits and biases are obtained. The standardized value is computed as the value minus the mean value, divided by the standard deviation. Then, we split the sample into the low and high groups by the mean of the computed standardized value. We find that CEO Big Five personality traits are positively associated with each other (except for neuroticism), in line with previous literature (Harrison et al., 2019).

Next, we provide pairwise correlations in Table 2. Excess monthly returns appear to be positively associated with CEO openness, extraversion, agreeableness, and overconfidence, but are negatively associated with CEO neuroticism. CEO conscientiousness and narcissism are not significantly related to the firm's excess stock returns. The correlation coefficients among CEO trait and bias variables are shown in the shaded area. Similar to the patterns found in Fig. 1, the Big Five traits except for neuroticism are positively correlated. CEO narcissism and overconfidence show inconsistent signs of the relationships with those trait variables.

4.2. Regression results

In this section, we examine our hypotheses on whether CEO personality traits explain the strategic flexibility of firms. Table 3 reports our results with CEO personality traits. Model 1 shows that none of the Big Five personality traits or narcissism are directly associated with performance as measured by excess return, except for the negative relationship of neuroticism. By contrast, overconfidence shows a positive association with excess return in line with Bharati et al. (2016). Model 2 includes the interactions between change in volatility and CEO personality traits. This model shows that CEOs who are less conscientious and less neurotic are better able to take advantage of an increase in firm-level volatility.

Effects that are statistically significant but economically insignificant have limited practical implications (Cuervo-Cazurra et al., 2013). The estimated coefficients on the interactions between change in volatility and conscientious and neurotic CEOs are −0.296, and − 0.278, respectively (Table 3). The standard deviation of change in volatility is 0.015 (Table 1). Finally, the differences between the 25th and 75th percentiles are 0.68 for CEO conscientiousness and 0.70 for CEO neuroticism (Table 1). An upward change in volatility corresponding to one standard deviation translates into an effect on excess monthly returns of −30 basis points and − 29 basis points for a change from the 25th percentile to the 75th percentile in CEO conscientiousness and CEO neuroticism, respectively. These figures correspond to annual absolute excess returns of 3.6%. Thus, the economic magnitude of our results is significant and fosters economic policy implications.

The results presented in Table 3 suggest that CEO conscientiousness and CEO neuroticism can have a detrimental impact on a firm's strategic flexibility. Our findings could also be interpreted through the lens of a conditional risk premium story, implying that the interaction effects we highlight may capture conditional volatility risk premia. To distinguish between these two mechanisms (strategic flexibility versus conditional risk premia), we conduct further analysis using operating performance measures (rather than excess returns) as dependent variables in the baseline model. Specifically, we conduct additional tests on quarterly ROA and on operating

Table 3
Value relevance of real options and CEO personality traits.

	Dependent variable = Excess monthly return	
	(1)	(2)
Market factor loading	−0.002	−0.002
	(−0.94)	(−0.96)
Book-to-market ratio	0.002	0.002
	(0.58)	(0.48)
Size	−0.003***	−0.003***
	(−4.98)	(−5.03)
Leverage	0.001	0.001
	(0.40)	(0.38)
Previous return	−0.009*	−0.009**
	(−1.93)	(−2.02)
Dividend payout	0.001	0.001
	(0.98)	(1.04)
Capital expenditures	−0.000	−0.000
	(−0.11)	(−0.15)
Volume	−0.013**	−0.012**
	(−2.32)	(−2.26)
ΔVolatility	−0.121**	2.565***
	(−2.51)	(2.71)
CEO age	−0.003	−0.003
	(−1.16)	(−1.01)
CEO tenure	−0.001**	−0.001**
	(−2.15)	(−2.42)
CEO gender	−0.001	−0.001
	(−0.73)	(−0.54)
CEO duality	−0.001	−0.001
	(−1.25)	(−1.29)
CEO education	0.001	0.001
	(1.00)	(1.04)
CEO salary and bonus	−0.018***	−0.018***
	(−10.48)	(−10.45)
CEO incentives	0.001***	0.001***
	(14.05)	(13.50)
CEO openness	0.000	−0.002
	(0.21)	(−1.01)
CEO conscientiousness	−0.002	−0.000
	(−0.99)	(−0.05)
CEO extraversion	−0.000	−0.000
	(−0.50)	(−0.53)
CEO agreeableness	0.000	0.001
	(0.19)	(0.50)
CEO neuroticism	−0.003*	−0.003*
	(−1.77)	(−1.69)
CEO narcissism	0.003	0.009
	(0.61)	(1.64)
CEO overconfidence	0.002**	0.002**
	(2.54)	(2.24)
ΔVolatility * CEO openness		0.051
		(0.35)
ΔVolatility * CEO conscientiousness		−0.296***
		(−3.21)
ΔVolatility * CEO extraversion		−0.104
		(−1.58)
ΔVolatility * CEO agreeableness		−0.016
		(−0.17)
ΔVolatility * CEO neuroticism		−0.278**
		(−2.46)
ΔVolatility * CEO narcissism		0.027
		(0.07)
ΔVolatility * CEO overconfidence		0.025
		(0.37)
Constant	0.104***	0.103***
	(4.81)	(4.63)
Observations	110,240	110,240
R-squared	0.147	0.168

t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10%, respectively.

Table 4
Value relevance of real options and CEO personality traits: Exploring ROA and operating cash flows.

Dependent variable =	ROA	Operating cash flows
	(1)	(2)
Market factor loading	−0.002***	−0.007***
	(−5.00)	(−12.27)
Book-to-market ratio	−0.042***	−0.063***
	(−27.29)	(−18.85)
Size	0.002***	0.005***
	(18.65)	(21.61)
Leverage	−0.024***	−0.049***
	(−27.28)	(−18.08)
Previous return	0.016***	0.027***
	(12.72)	(11.81)
Dividend payout	0.001***	0.003***
	(7.29)	(7.75)
Capital expenditures	−0.016***	0.011***
	(−8.13)	(5.17)
Volume	−0.004***	0.010***
	(−3.07)	(4.84)
ΔVolatility	0.562	0.643
	(1.38)	(1.11)
CEO age	−0.001	0.011***
	(−1.16)	(7.00)
CEO tenure	0.001***	0.000**
	(6.46)	(2.19)
CEO gender	0.001***	0.005***
	(2.92)	(5.04)
CEO duality	−0.000	−0.003***
	(−0.26)	(−6.99)
CEO education	−0.001**	−0.005***
	(−2.22)	(−12.44)
CEO salary and bonus	0.001	0.008***
	(1.21)	(10.72)
CEO incentives	0.000***	0.001***
	(12.37)	(12.05)
CEO openness	−0.001**	0.016***
	(−2.10)	(14.61)
CEO conscientiousness	0.004***	−0.003***
	(7.22)	(−4.68)
CEO extraversion	0.002***	−0.001**
	(2.91)	(−2.48)
CEO agreeableness	−0.004***	−0.004***
	(−9.68)	(−7.25)
CEO neuroticism	0.003***	0.017***
	(5.43)	(13.09)
CEO narcissism	−0.005***	−0.026***
	(−2.80)	(−10.06)
CEO overconfidence	0.000	0.000
	(1.25)	(0.15)
ΔVolatility * CEO openness	−0.008	−0.097
	(−0.15)	(−1.24)
ΔVolatility * CEO conscientiousness	−0.051**	0.022
	(−2.04)	(0.41)
ΔVolatility * CEO extraversion	−0.013	0.011
	(−0.40)	(0.21)
ΔVolatility * CEO agreeableness	0.012	0.013
	(0.43)	(0.26)
ΔVolatility * CEO neuroticism	−0.095*	−0.134*
	(−1.75)	(−1.75)
ΔVolatility * CEO narcissism	0.127	0.021
	(0.89)	(0.07)
ΔVolatility * CEO overconfidence	−0.038	−0.025
	(−1.65)	(−0.58)
Constant	−0.013*	−0.147***
	(−1.89)	(−10.04)
Observations	110,192	110,204
R-squared	0.218	0.174

t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10%, respectively.

cash flows adjusted by total assets. Because these new dependent variables are not monthly data points by nature, we would not be surprised to find weaker associations. In these additional tests, we find that the negative effects associated with CEO conscientiousness and CEO neuroticism, observed in Table 3, persist, albeit to a lesser extent.

As shown in Table 4, the coefficients of the interaction terms between ΔVolatility and CEO conscientiousness and neuroticism in the regression involving ROA are statistically significant at the 5% and 10% levels, respectively. For operational cash flows, the interacting effect of CEO neuroticism remains significant, while that of CEO conscientiousness becomes insignificant. We conclude that CEO conscientiousness and neuroticism may hinder strategic flexibility.

To make statements about the probability that the null hypothesis is true, we follow Harvey (2017) in creating Bayesian *p*-values based on the minimum Bayes factor (MBF; Edwards et al., 1963) and the symmetric-and-descending Bayes Factor (SD-MBF; Bayarri and Berger, 1998). While the MBF gives the strongest evidence against the null hypothesis, the SD-MBF is less aggressive and relevant for a situation in which we do not have strong prior beliefs about the direction of our hypothesized effect. We also include sample-size adjusted Bayes factors with balanced error rates (Gu et al., 2016) that we compute using the alphaN package (Wulff and Taylor, in press). The Bayesian *p*-values presented in Table 5 indicate whether the null hypothesis of no effect is true based on our data and series of skeptical priors. In Panel A, we see that even if we believe a priori that the chance of Hypothesis 2 (a negative association with CEO conscientiousness) being true is only 20% (4-to-1), we estimate a 2% probability (9% for SD-MBF and 6% if the sample size is taken into account) that the null is true after having seen the data. Our evidence is weaker with respect to Hypothesis 5 (a negative association of the firm's ability to exploit an increase in volatility with CEO neuroticism) where a person finding Hypothesis 5 to be 50% (1-to-1) likely (prior to seeing the data) would rationally believe a 5% probability (14% SD-MBF and 11% sample-size adjusted) of the null being true after seeing the data. In short, our inferences are particularly strong with respect to Hypothesis 2 (conscientiousness) when accounting for various skeptical prior probabilities for our hypotheses.

4.3. CEO traits, investment, and other corporate strategies

In this section, we explore various dimensions of firm dynamics to provide more insight into the interplay between CEO personality traits and firms' strategic flexibility. Thus, we conduct an in-depth analysis encompassing corporate investment, including capital expenditures, R&D intensity, acquisitions, as well as other strategic factors, such as capital structure and payout policy. The comprehensive results are presented in Table 6.

First, we assess how CEO traits are associated with corporate decisions at the firm-year level. As reported in Panel A of Table 6, the findings indicate the significance of CEO traits in shaping investment and corporate dynamics, with 11 out of 25 coefficients displaying statistical significance at the 10% level. Our model also shows that CEO overconfidence is positively associated with corporate acquisitions, consistent with the evidence of prior studies (Malmendier and Tate, 2008; Aabo et al., 2023).

In Panel B, we examine the interaction between these variables and CEO traits in terms of excess yearly stock returns. Our analysis reveals several interesting interacting effects of CEO traits. The most significant of these is the interaction effect between CEO extraversion and corporate acquisition. The positive performance implications of this interaction are in line with previous literature

Table 5
Bayesian *P*-values for the probability of the null hypothesis being true.

				Prior beliefs (Odds, Null: Alternative)			
				Long shot			Even odds
				99-to-1	19-to-1	4-to-1	1-to-1
	z-score	*p*-value	MBF	0.01	0.05	0.20	0.50
Panel A: MBF							
ΔVolatility * CEO conscientiousness	−3.21	0.0013	0.006	0.36	0.10	0.02	0.01
ΔVolatility * CEO neuroticism	−2.46	0.0139	0.049	0.83	0.48	0.16	0.05
Panel B: SD-MBF							
ΔVolatility * CEO conscientiousness	−3.21	0.0013	0.024	0.70	0.31	0.09	0.02
ΔVolatility * CEO neuroticism	−2.46	0.0139	0.162	0.94	0.75	0.39	0.14
Panel C: AAFBF							
ΔVolatility * CEO conscientiousness	−3.21	0.0013	0.015	0.60	0.22	0.06	0.01
ΔVolatility * CEO neuroticism	−2.46	0.0139	0.126	0.93	0.71	0.34	0.11

This table reports the probability that the null is true for Hypotheses 2 and 5. MBF is the minimum Bayes factor, $\exp.(-z^2/2)$; SD-MBF is the symmetric-descending minimum Bayes factor, $-\exp(1) \times p\text{-value} \times \ln(p\text{-value})$; AAFBF is the approximated adjusted fractional Bayes factor, $b_n^{1/2} exp\left(\frac{1}{2}W\right)$, where W is the Wald statistic and the sample size, n, enters through the expression $b_n^{1/2} = \int_0^1 exp\left(-n\beta_e^2/4\right)d\beta_e$ assuming realistic and uniformly distributed effect sizes $\beta_e \in [0,1]$. The Bayesian *p*-value is computed as MBF × prior odds / (1 + MBF × prior odds).

(Malhotra et al., 2018; Green et al., 2019; Aabo et al., 2023).

Table 6
CEO traits, investments, and other corporate strategies.

Panel A: Regression of investments and other corporate strategies

Dependent variable =	Capital expenditures	R&D intensity	Acquisitions	Leverage	Dividend payout
	(1)	(2)	(3)	(4)	(5)
Size	0.002	−0.005***	0.031***	0.016***	0.023***
	(0.35)	(−2.80)	(4.81)	(4.58)	(2.74)
Book-to-market ratio	−0.019	−0.046***	0.063*	−0.008	−0.258***
	(−0.55)	(−4.17)	(1.95)	(−0.30)	(−4.60)
Leverage	0.089	−0.006	−0.010		0.034
	(1.38)	(−0.40)	(−0.27)		(0.54)
Previous return	0.071	−0.009**	0.007	−0.006	0.065***
	(1.34)	(−2.28)	(0.42)	(−0.82)	(2.87)
Dividend payout	−0.007	−0.005**	−0.005	0.004	
	(−1.27)	(−2.11)	(−0.55)	(0.55)	
Capital expenditures		0.027***	0.000	0.013	−0.008*
		(13.62)	(0.04)	(1.03)	(−1.67)
Volume	0.162***	0.014	−0.085***	0.110***	−0.214***
	(2.70)	(1.56)	(−2.78)	(3.89)	(−4.34)
ΔVolatility (monthly average)	1.098	−1.675**	2.402	−5.156***	0.573
	(0.49)	(−2.39)	(1.18)	(−5.25)	(0.26)
Market valuation	−0.003	−0.033***	0.024**	0.035**	−0.035
	(−0.24)	(−11.56)	(2.07)	(1.97)	(−1.49)
CEO age	−0.207	−0.009	−0.035	0.027	0.072
	(−1.38)	(−0.54)	(−0.63)	(0.77)	(1.08)
CEO tenure	0.017	0.003	−0.001	−0.004	0.010
	(1.50)	(1.50)	(−0.21)	(−0.83)	(1.07)
CEO gender	−0.017	−0.011*	−0.065**	−0.005	0.011
	(−0.98)	(−1.92)	(−2.33)	(−0.25)	(0.15)
CEO duality	−0.011	0.005	0.001	0.010	0.005
	(−1.21)	(1.23)	(0.12)	(1.15)	(0.34)
CEO education	−0.014	−0.008**	−0.002	−0.013*	0.028*
	(−1.34)	(−2.38)	(−0.19)	(−1.77)	(1.76)
CEO salary and bonus	0.031	−0.013	−0.061***	−0.048***	0.072*
	(1.19)	(−1.54)	(−2.73)	(−2.72)	(1.93)
CEO incentives	−0.002	−0.000	0.001	−0.001	−0.006***
	(−1.06)	(−1.33)	(0.46)	(−1.13)	(−4.33)
CEO openness	−0.098	0.018*	−0.028	−0.020	−0.052
	(−1.28)	(1.71)	(−0.94)	(−0.92)	(−1.00)
CEO conscientiousness	0.060*	−0.051***	0.012	0.018	0.134***
	(1.84)	(−6.45)	(0.47)	(1.04)	(3.45)
CEO extraversion	−0.038	−0.023***	0.015	0.023***	0.001
	(−1.31)	(−4.26)	(1.34)	(2.61)	(0.07)
CEO agreeableness	−0.013	0.040***	0.026	−0.024*	−0.043*
	(−0.46)	(5.13)	(1.38)	(−1.95)	(−1.75)
CEO neuroticism	−0.042	−0.044***	−0.004	0.043***	−0.025
	(−0.52)	(−4.52)	(−0.18)	(2.61)	(−0.80)
CEO narcissism	−0.147*	0.037	−0.011	0.020	0.054
	(−1.69)	(1.27)	(−0.15)	(0.37)	(0.53)
CEO overconfidence	0.015	−0.006*	0.028**	0.005	−0.067***
	(1.07)	(−1.67)	(2.48)	(0.65)	(−4.16)
Constant	1.362	0.519***	−0.563*	−0.418**	−0.763**
	(1.07)	(4.45)	(−1.79)	(−2.11)	(−2.09)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	8376	8376	8376	8376	8376
R-squared	0.109	0.559	0.090	0.225	0.116

Panel B: Interacting effects of corporate strategies on excess stock returns

	Dependent variable = Excess yearly return				
	Corporate strategy variables				
	Capital expenditures	R&D intensity	Acquisitions	Leverage	Dividend payout
	(1)	(2)	(3)	(4)	(5)
CEO openness	0.011	−0.001	0.007	−0.008	0.010
	(0.80)	(−0.09)	(0.48)	(−0.42)	(0.71)
CEO conscientiousness	−0.040***	−0.018	−0.045***	−0.032**	−0.042***

Table 6 (*continued*)

Panel B: Interacting effects of corporate strategies on excess stock returns					
	Dependent variable = Excess yearly return				
	Corporate strategy variables				
	Capital expenditures	R&D intensity	Acquisitions	Leverage	Dividend payout
	(1)	(2)	(3)	(4)	(5)
	(−3.21)	(−1.41)	(−3.61)	(−2.06)	(−3.36)
CEO extraversion	−0.001	−0.000	−0.010	0.003	−0.001
	(−0.24)	(−0.02)	(−1.56)	(0.34)	(−0.10)
CEO agreeableness	0.008	0.005	0.013	0.004	0.008
	(0.94)	(0.48)	(1.45)	(0.29)	(0.86)
CEO neuroticism	−0.011	−0.007	−0.016	−0.014	−0.009
	(−1.10)	(−0.63)	(−1.53)	(−0.96)	(−0.84)
CEO narcissism	−0.020	0.017	0.012	−0.046	−0.020
	(−0.53)	(0.45)	(0.32)	(−0.83)	(−0.50)
CEO overconfidence	0.025***	0.025***	0.024***	0.012	0.030***
	(4.02)	(4.03)	(3.78)	(1.36)	(4.40)
Corporate strategy * CEO openness	−0.056	0.101	−0.009	0.073	−0.015
	(−0.83)	(0.89)	(−0.34)	(1.04)	(−0.67)
Corporate strategy * CEO conscientiousness	0.044	−0.221**	0.038**	−0.024	0.026
	(0.74)	(−1.97)	(2.02)	(−0.43)	(1.35)
Corporate strategy * CEO extraversion	−0.009	0.028	0.048***	−0.020	−0.008
	(−0.57)	(0.88)	(4.00)	(−0.74)	(−0.79)
Corporate strategy * CEO agreeableness	0.029	0.009	−0.012	0.031	0.014
	(0.72)	(0.14)	(−0.65)	(0.75)	(0.95)
Corporate strategy * CEO neuroticism	0.011	−0.012	0.049**	0.023	−0.001
	(0.93)	(−0.16)	(2.35)	(0.43)	(−0.03)
Corporate strategy * CEO narcissism	0.184	−0.692*	−0.151*	0.164	0.046
	(0.99)	(−1.93)	(−1.67)	(0.73)	(0.71)
Corporate strategy * CEO overconfidence	0.050**	0.084	0.021*	0.076**	−0.007
	(2.10)	(1.30)	(1.66)	(2.25)	(−0.52)
Firm variables	Yes	Yes	Yes	Yes	Yes
CEO variables	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	8369	8369	8369	8369	8369
R-squared	0.662	0.662	0.662	0.662	0.662

t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10%, respectively.

4.4. Strategic flexibility around CEO turnovers

Next, we examine the influence of CEO personality traits in the context of CEO turnovers. A comparative analysis involving two CEOs with contrasting personality traits enriches our understanding of the central findings, although the limited number of CEO turnovers is likely to result in less significant findings. We scrutinize the periods both before and after CEO turnovers, spanning three years for each period. We employ standardized values, calculated as the value minus the mean divided by the standard deviation, as illustrated in Fig. 1. Each month, we categorize firms into either high or low groups based on the standardized value of each trait variable, using the median as the dividing point. Subsequently, we conduct distinct regression analyses for four different groups and report the coefficients for the key variable (i.e., *ΔVolatility*) in Table 7, Panel A. In Models 1 and 2, we compare the interacting effects within two subsets: old CEOs (before the turnover) with low trait scores and new CEOs (after the turnover) with high trait scores. Models 3 and 4 involve a comparison between old CEOs with high trait scores and new CEOs with low trait scores. A main difference that is significant at the 5% level is the case of a highly conscientious CEO being replaced by a CEO with low conscientiousness. In line with our previous arguments and findings, such CEO replacement is advantageous in terms of the ability to exploit an increase in volatility.

CEO turnovers can be endogenous events. To alleviate endogeneity concerns, we next examine exogenous CEO turnover events only (Eisfeldt and Kuhnen, 2013; Peters and Wagner, 2014) in Table 7, Panel B. We utilize data from Gentry et al. (2021) and consider a CEO turnover as exogenous when it is related to an involuntary CEO departure resulting from factors such as death, illness, job performance issues or legal violations and concerns.[2] In our analysis, we identify a total of 253 such exogenous CEO turnovers. Given the relatively small number of observations, we extend the test period from 3 to 7 years (when available). Panel B shows that the only difference that is significant is the case of a highly neurotic CEO being replaced by a CEO low in neuroticism. In line with our previous arguments and findings – and in line with the result on CEO conscientiousness in Panel A - such CEO replacement is advantageous in terms of the ability to exploit an increase in volatility. Collectively, the findings in Table 7 support our previous conclusions.

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[2] We appreciate the authors sharing the CEO dismissal data.

Table 7
Strategic flexibility around CEO turnovers.

Panel A: Strategic flexibility around CEO turnovers with trait changes – All CEO turnovers						
	(1) Old CEOs with low trait	(2) New CEOs with high trait	(1)–(2)	(3) Old CEOs with high trait	(4) New CEOs with low trait	(3)–(4)
By CEO openness						
ΔVolatility	4.052	7.709**	−3.6570	−2.386	6.457	−8.8430*
	(0.97)	(2.45)	[0.242]	(−0.73)	(1.50)	[0.051]
By CEO conscientiousness						
ΔVolatility	7.449*	3.933	3.5160	−2.010	8.439*	−10.4490**
	(1.67)	(1.19)	[0.264]	(−0.62)	(1.96)	[0.026]
By CEO extraversion						
ΔVolatility	1.514	6.632**	−5.1180	−3.261	1.630	−4.8910
	(0.53)	(2.13)	[0.113]	(−0.90)	(0.45)	[0.171]
By CEO agreeableness						
ΔVolatility	8.905**	9.536***	−0.6310	−2.713	0.512	−3.2250
	(2.21)	(3.60)	[0.448]	(−0.76)	(0.10)	[0.302]
By CEO neuroticism						
ΔVolatility	−2.262	2.362	−4.6240	8.845**	11.737***	−2.8920
	(−0.73)	(0.56)	[0.189]	(2.46)	(3.96)	[0.268]

Panel B: Strategic flexibility around CEO turnovers with trait changes – Exogenous CEO turnovers						
	(1) Old CEOs with low trait	(2) New CEOs with high trait	(1)–(2)	(3) Old CEOs with high trait	(4) New CEOs with low trait	(3)–(4)
By CEO openness						
ΔVolatility	3.641	8.682	−5.041	6.958*	3.563	3.395
	(0.52)	(1.33)	[0.298]	(1.95)	(0.20)	[0.425]
By CEO conscientiousness						
ΔVolatility	6.352	5.650	0.702	3.488	−1.235	4.723
	(1.00)	(0.60)	[0.476]	(0.93)	(−0.11)	[0.345]
By CEO extraversion						
ΔVolatility	3.160	1.368	1.792	4.946	−3.802	8.748
	(0.82)	(0.21)	[0.405]	(1.00)	(−0.49)	[0.171]
By CEO agreeableness						
ΔVolatility	5.737	5.270	0.467	8.574**	−2.728	11.302
	(0.87)	(0.85)	[0.480]	(2.47)	(−0.22)	[0.189]
By CEO neuroticism						
ΔVolatility	6.329*	−2.501	8.830	−3.019	11.772*	−14.791**
	(1.74)	(−0.24)	[0.212]	(−0.51)	(1.79)	[0.048]

t-statistics (*p*-values) are reported in parentheses (brackets). ***, **, and * indicate significance at the 1%, 5%, and 10%, respectively.

4.5. Panel regression analysis and structural equation modeling

While our interaction effects are measured with high precision, one might be concerned that multicollinearity is inflating the standard errors thereby making us unable to detect the other interaction effects. The variance inflation factors (VIF) for our interactions with respect to openness, conscientiousness, extraversion, agreeableness, neuroticism, narcissism, and overconfidence are 6.04, 2.35, 1.73, 4.16, 3.72, 1.01, and 1.02 respectively, suggesting minimal inflation of the standard errors due to the other predictors.

According to Petersen (2009), the most common methods in recent empirical tests are the Fama and MacBeth (1973) rolling regression procedure, panel regressions, and cluster-correcting models. Consequently, we run a panel data regression with year-fixed effects and standard errors clustered at the firm level in Table 8. In Models 1 and 2, we apply both time-invariant firm effects (firm fixed effects) and random firm effects (Petersen, 2009). The results strongly support Hypothesis 2 (a negative association with CEO conscientiousness) and Hypothesis 5 (a negative association with CEO neuroticism).

We have treated the volatility of a firm's assets to be exogenous to CEO personality traits but recognize that it may interact with CEO traits when estimating excess stock returns. However, the volatility of a firm's assets is influenced by the firm's business model and operations, both of which have been shown in the literature to be strongly correlated with CEO personality traits (e.g., Malmendier and Tate, 2005; Malmendier et al., 2011; Bernile et al., 2017).

To address this circularity, we employ structural equation modeling (SEM) to simultaneously estimate two equations: one for ΔVolatility of assets and another for excess returns, as presented in Models 3 and 4. In Model 3, which assesses the impact of CEO personality traits on ΔVolatility of assets, our findings do not reveal any statistically significant associations. This suggests that while CEO traits may influence the volatility of a firm's assets, they do not appear to have a direct relationship with changes in volatility. In Model 4, which examines excess stock returns, we consistently find negative associations with CEO conscientiousness and neuroticism.

Our panel regression and SEM results indicate a negative association with CEO extraversion, which does not support Hypothesis 3. In our hypothesis development, we may have focused too much on the bright side of extraversion. However, extraversion may also

Table 8
Panel regression analysis and structural equation modeling.

Dependent variable =	Excess monthly return	Excess monthly return	ΔVolatility	Excess monthly return
	Fixed effect model	Random effect model	Structural equation modeling	
	(1)	(2)	(3)	(4)
Market factor loading	0.005***	0.005***		0.005***
	(6.71)	(7.21)		(10.37)
Book-to-market ratio	−0.000	0.009***		0.009***
	(−0.03)	(3.90)		(4.27)
Size	−0.026***	−0.003***		−0.003***
	(−20.37)	(−9.86)		(−10.92)
Leverage	0.004	0.003		0.003
	(0.96)	(1.41)		(1.34)
Previous return	−0.027***	−0.018***		−0.018***
	(−15.27)	(−10.36)		(−13.48)
Dividend payout	0.000	0.001**		0.001*
	(0.21)	(2.00)		(1.75)
Capital expenditures	0.002**	0.002***		0.002*
	(2.08)	(3.04)		(1.89)
Volume	−0.049***	−0.029***		−0.029***
	(−9.00)	(−9.49)		(−14.20)
ΔVolatility	2.424***	2.381***		5.139
	(2.79)	(2.68)		(0.08)
Market valuation	0.001***	0.001***		0.001***
	(18.27)	(19.08)		(21.03)
CEO age	0.004	−0.003		−0.003
	(0.62)	(−0.98)		(−0.97)
CEO tenure	−0.003***	−0.001**		−0.001**
	(−4.12)	(−2.43)		(−2.54)
CEO gender	0.001	−0.000		−0.000
	(0.25)	(−0.25)		(−0.19)
CEO duality	0.000	−0.001		−0.001
	(0.30)	(−1.58)		(−1.41)
CEO education	0.002**	0.001		0.001
	(1.97)	(1.48)		(1.30)
CEO salary and bonus	−0.032***	−0.021***		−0.021***
	(−10.71)	(−9.32)		(−11.33)
CEO incentives	0.002***	0.001***		0.001***
	(12.41)	(10.48)		(17.28)
CEO openness	−0.002	0.000	−0.000	0.001
	(−0.40)	(0.35)	(−0.42)	(0.13)
CEO conscientiousness	0.004	−0.000	0.000	−0.000
	(1.14)	(−0.09)	(0.14)	(−0.09)
CEO extraversion	−0.002	−0.000	0.000	−0.000
	(−1.47)	(−0.49)	(0.09)	(−0.36)
CEO agreeableness	−0.002	−0.001	0.000	−0.001
	(−1.02)	(−0.76)	(0.33)	(−0.29)
CEO neuroticism	−0.005	−0.004***	0.000	−0.004
	(−1.59)	(−3.71)	(0.29)	(−1.26)
CEO narcissism	−0.001	0.002	−0.000	0.002
	(−0.10)	(0.49)	(−0.14)	(0.31)
CEO overconfidence	0.010***	0.003***	0.000	0.002
	(7.76)	(3.78)	(0.71)	(0.56)
ΔVolatility * CEO openness	0.152	0.147		0.147
	(1.18)	(1.13)		(1.55)
ΔVolatility * CEO conscientiousness	−0.225***	−0.223***		−0.223***
	(−2.89)	(−2.83)		(−3.42)
ΔVolatility * CEO extraversion	−0.137**	−0.136**		−0.136***
	(−2.56)	(−2.54)		(−3.80)
ΔVolatility * CEO agreeableness	−0.066	−0.057		−0.057
	(−0.92)	(−0.80)		(−1.08)
ΔVolatility * CEO neuroticism	−0.473***	−0.483***		−0.483***
	(−4.51)	(−4.50)		(−7.34)
ΔVolatility * CEO narcissism	−0.410	−0.392		−0.392
	(−1.10)	(−1.03)		(−1.46)
ΔVolatility * CEO overconfidence	0.067	0.073		0.073*
	(1.12)	(1.20)		(1.67)
Constant	0.562***	0.080***	0.003**	0.072
	(13.05)	(5.31)	(2.40)	(0.39)
Year and month fixed effects	Yes	Yes	Yes	Yes

Table 8 (*continued*)

Dependent variable =	Excess monthly return	Excess monthly return	ΔVolatility	Excess monthly return
	Fixed effect model	Random effect model	Structural equation modeling	
	(1)	(2)	(3)	(4)
Firm fixed effects	Yes	No	No	No
Firm random effects	No	Yes	No	No
Observations	110,240	110,240	110,240	110,240
R-squared	0.067	0.059		

t-statistics and *z*-statistics for the fixed effect and the random effect models, respectively, are reported in parentheses and standard errors are clustered at the firm level. ***, **, and * indicate significance at the 1%, 5%, and 10%, respectively.

have a dark side which may inhibit the exploitation of increased volatility. Such a dark side may involve 1) the reluctance to solicit input from subordinates as the extraverted CEO overestimates own capabilities, 2) the lack of a clear strategic focus as the extraverted CEO engages in short and shallow discussions rather than in-depth ones, and 3) the tendency to change course prematurely as the extraverted CEO has short-lived enthusiasm for projects, people, and ideas (Judge et al., 2009). These dark sides may be behind the negative coefficients for the interaction term between CEO extraversion and change in volatility in Table 8.

4.6. Robustness tests

In our robustness tests, we perform analysis on alternative samples. Our main sample excludes small firms (with market cap of less than 100 million $). We find that our previous conclusions hold when we include small firms (Table 9, Model 1). In an untabulated test, we use other cutoffs (e.g., 50 or 30 million dollars) to drop small firms and find similar results. We further exclude the financial crisis (2007 December - 2009 June) and show that our results are not driven by the crisis years (Table 9, Model 2).

As explained in Section 3.1, our sample contains S&P 1500 firms with information in ExecuComp for all fiscal years from 2007 to 2018. This sample construction aligns with the methodology used in prior studies (e.g., Ham et al., 2018). We observe that a significant portion (74% of the sample) is present in the S&P 1500 throughout the entire period from 2007 to 2018 (144 months). To mitigate potential survivorship bias, we re-evaluate our main model by excluding firms if they are not included in the complete period. Model 3 shows that our results remain consistent. Although this additional test helps alleviate concerns related to survivorship bias, we acknowledge its limitations in that our approach could still introduce some bias.

In our main analysis, we rely on the positive contemporaneous relation between returns and changes in return volatility as a measure of strategic flexibility. Such a positive relation induces positive return skewness. While positive skewness is consistent with the real option theory, it could also be in line with the leverage hypothesis (i.e., higher volatility results in higher stock valuations due to the option-like nature of equity). Model 4 excludes firms in the bottom tercile of leverage (i.e., the firms where the leverage hypothesis is least likely to play a role). We see that the coefficient for *ΔVolatility* is markedly higher for this subsample (that excludes low leverage firms and hence contains more high-leverage firms) in line with the leverage hypothesis. Nonetheless, we also see that the results for the interaction terms involving CEO conscientiousness and CEO neuroticism remain in line with our previous findings and thus broadly support our interpretation that strategic flexibility is a key driver of this effect.

Grullon et al. (2012) show that the value relevance of real options is more pronounced in industries that are known to have high levels of operational flexibility (such as natural resources industries) and plenty of growth and strategic options (such as high-tech, pharmaceutical, and biotechnology industries). Hence, we examine for robustness whether our results are driven by these industries. Following Grullon et al. (2012), we define the aforementioned industries based on the Fama and French 49 industry classification.[3] Natural resources industries include metals (code 27), mining (28), and oil and natural gas (30). High-tech industries comprise electrical equipment (22), telecommunications (32), computer hardware (35), computer software (36), electronic equipment (37), and measuring and control equipment (38). Pharmaceutical and biotechnology industries contain medical equipment (12) and pharmaceutical products (13). As expected, we find weaker but qualitatively similar results after dropping the industries with high operational flexibility. The complete results are available upon request.

4.7. Controlling for endogeneity

To alleviate endogeneity concerns, we quantify how strong unobserved confounding needs to be to substantially change our research conclusions with respect to CEO conscientiousness and CEO neuroticism. We use the user-written Stata command konfound to compute the Robustness of Inference to Replacement (RIR) and the Impact Threshold of a Confound Variable (ITCV) (Xu et al., 2019). RIR provides information about how the data would have to change to overturn our inferences (Frank and Min, 2007). To invalidate our inferences, 38.77% and 20.49% of the estimate of CEO conscientiousness and CEO neuroticism, respectively, would have to be due to bias. The ITCV quantifies how strongly correlated an omitted variable would have to be with the predictor of interest and the outcome to make a coefficient deemed statistically significant no longer so (Busenbark et al., 2021). An omitted variable would have to

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[3] Fama and French (1997) introduce the 48 industry classifications, which have been extended to the 49 industry classifications, where the computer industry (code 35) is split into hardware (35) and software (36).

Table 9
Value relevance of real options and CEO personality traits – alternative samples.

	Dependent variable = Excess monthly return			
	Including the small firms (< $100 million)	Excluding financial crisis (2007 December – 2009 June)	Excluding firms that do not exist in the entire sample period	Excluding firms in the bottom tercile of leverage
	(1)	(2)	(3)	(4)
Market factor loading	−0.003	−0.003	−0.002	−0.003
	(−1.56)	(−1.35)	(−0.74)	(−1.05)
Book-to-market ratio	0.004	0.001	0.001	0.001
	(0.97)	(0.20)	(0.29)	(0.30)
Size	−0.003***	−0.003***	−0.003***	−0.003***
	(−5.91)	(−4.93)	(−4.40)	(−5.26)
Leverage	0.005	0.003	0.001	−0.001
	(1.29)	(1.04)	(0.28)	(−0.35)
Previous return	−0.008*	−0.006	−0.011**	−0.008
	(−1.67)	(−1.55)	(−2.33)	(−1.52)
Dividend payout	0.001	0.000	0.001	0.002*
	(1.03)	(0.52)	(0.59)	(1.78)
Capital expenditures	0.000	0.000	−0.003	−0.000
	(0.07)	(0.04)	(−0.68)	(−0.02)
Volume	−0.009	−0.013**	−0.008	−0.010*
	(−1.47)	(−2.25)	(−1.33)	(−1.77)
ΔVolatility	2.640***	2.423**	2.954***	4.828***
	(2.97)	(2.45)	(2.86)	(4.05)
CEO age	−0.003	−0.002	−0.004	0.001
	(−1.20)	(−0.73)	(−1.32)	(0.14)
CEO tenure	−0.001***	−0.001**	−0.001**	−0.001
	(−2.83)	(−2.04)	(−2.34)	(−1.33)
CEO gender	−0.001	0.000	−0.001	−0.000
	(−0.48)	(0.23)	(−0.32)	(−0.13)
CEO duality	−0.001	−0.000	0.000	−0.001*
	(−1.21)	(−0.86)	(0.11)	(−1.76)
CEO education	0.001	0.001	0.001	0.001
	(1.52)	(0.81)	(1.28)	(1.17)
CEO salary and bonus	−0.017***	−0.017***	−0.016***	−0.017***
	(−9.11)	(−9.42)	(−9.34)	(−7.22)
CEO incentives	0.001***	0.001***	0.001***	0.001***
	(13.76)	(13.79)	(12.18)	(12.25)
CEO openness	−0.002	−0.002	−0.002	−0.001
	(−1.04)	(−1.09)	(−1.24)	(−0.45)
CEO conscientiousness	−0.000	−0.001	−0.001	−0.001
	(−0.04)	(−0.73)	(−0.27)	(−0.54)
CEO extraversion	−0.000	−0.000	−0.000	−0.000
	(−0.35)	(−0.47)	(−0.61)	(−0.29)
CEO agreeableness	0.001	0.000	0.002	0.002
	(0.93)	(0.41)	(1.43)	(1.24)
CEO neuroticism	−0.002	−0.003*	−0.001	−0.001
	(−1.37)	(−1.84)	(−0.93)	(−0.71)
CEO narcissism	0.007	0.002	0.006	0.009
	(1.32)	(0.44)	(1.12)	(1.24)
CEO overconfidence	0.002**	0.002**	0.001	0.002*

Table 9 (*continued*)

	Dependent variable = Excess monthly return			
	Including the small firms (< $100 million)	Excluding financial crisis (2007 December – 2009 June)	Excluding firms that do not exist in the entire sample period	Excluding firms in the bottom tercile of leverage
	(1)	(2)	(3)	(4)
	(2.53)	(2.21)	(1.41)	(1.88)
ΔVolatility * CEO openness	−0.045	−0.072	−0.011	−0.026
	(−0.34)	(−0.49)	(−0.06)	(−0.13)
ΔVolatility * CEO conscientiousness	−0.264***	−0.268***	−0.313***	−0.351**
	(−2.85)	(−2.66)	(−2.91)	(−2.44)
ΔVolatility * CEO extraversion	−0.059	−0.081	−0.042	−0.106
	(−1.02)	(−1.18)	(−0.60)	(−1.32)
ΔVolatility * CEO agreeableness	0.009	0.086	−0.058	−0.168
	(0.11)	(0.92)	(−0.56)	(−1.43)
ΔVolatility * CEO neuroticism	−0.281***	−0.247**	−0.313**	−0.502***
	(−2.75)	(−2.08)	(−2.55)	(−3.56)
ΔVolatility * CEO narcissism	−0.351	−0.087	0.072	−0.748
	(−0.98)	(−0.21)	(0.18)	(−1.45)
ΔVolatility * CEO overconfidence	0.030	0.021	−0.006	−0.101
	(0.47)	(0.28)	(−0.08)	(−1.10)
Constant	0.114***	0.112***	0.096***	0.086***
	(5.34)	(4.81)	(4.26)	(3.32)
Observations	114,450	96,493	82,080	73,427
R-squared	0.164	0.166	0.192	0.213

t-statistics are reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10%, respectively.

be correlated at 0.061 with the outcome and with CEO conscientiousness (conditioning on observed covariates) to invalidate an inference at an alpha of 5%. The corresponding correlation is 0.039 for CEO neuroticism. Among our control variables, the variable with the largest impact is CEO incentives. CEO incentives exhibits an impact of 0.0001, which is lower $\left(\sqrt{0.0001} = 0.01\right)$ than the correlations needed to invalidate our inferences. Finally, we use the recent suite of sensitivity tools proposed by Cinelli and Hazlett (2020), which uses formal benchmarking to bound the plausible strength of unobserved confounders. The formal sensitivity analysis reveals that with respect to CEO conscientiousness (H2), the point estimate and statistical inference are robust to confounders more than three times as strong as CEO salary and bonus, the strongest observed control variable. A confounder three times as strong as CEO salary and bonus would only reduce the point estimate from -0.296 to -0.119, which would still be significant at the 5% level. An extreme confounder that explains 100% of the residual variance of the outcome would need to explain at least 7.99% residual variance of the treatment to fully account for the observed effect of neuroticism. This is notably higher than the partial R^2 bound of 3% from a confounder three times as strong as CEO salary and bonus, suggesting that our results with respect to CEO conscientiousness are robust even to an extreme scenario.

The estimate of the interaction with CEO neuroticism (H5) is more sensitive to unobserved confounders. A confounder as strong as market factor loading (the strongest observed control with respect to neuroticism) would reduce the point estimate of neuroticism from -0.28 to -0.183 and it would still be statistically significant at the 10% level. However, a confounder twice as strong as market factor loading would reduce the estimate to zero and turn it insignificant. The estimate of the interaction with neuroticism is robust to an extreme scenario where the confounder explains 100% of the residual variance of the outcome and is about 1/5th as strong as market factor loading, but not in extreme scenarios where the confounder is stronger.

Based on the four complementary approaches used herein (Fama-MacBeth cross-sectional rolling regressions in Table 3, Bayesian p-values in Table 5, panel data regression in Table 8, and three different sensitivity techniques), we find no support for Hypothesis 1 (a positive association with CEO openness to experience), strong support for Hypothesis 2 (a negative association with CEO conscientiousness), no support for Hypothesis 3 (a positive association with CEO extraversion), no support for Hypothesis 4 (a negative association with CEO agreeableness), and some support for Hypothesis 5 (a negative association with CEO neuroticism).

5. Discussion and conclusions

We have investigated the relationship between CEO personality traits and the firm's strategic flexibility in the period 2007–2018 for a sample of non-financial S&P 1500 firms. We find that a firm's strategic flexibility is worsened by CEO conscientiousness and CEO neuroticism. These findings are in line with our posited hypotheses. Our findings can also be seen as empirical manifestations of the trait activation theory (Tett and Burnett, 2003; Judge and Zapata, 2015). In increasingly stormy waters, managers that are too conscientious and neurotic are not well suited to take advantage of the firm's inherent strategic flexibility, while the same managers are quite effective to lead in more stable environments.

We expected to find a positive association between CEO openness to experience and the firm's ability to take advantage of heightened volatility. The same holds for CEO extraversion, while we expected a negative association between CEO agreeableness and the firm's ability to take advantage of heightened volatility. None of these expectations were supported in our empirical tests. If anything, we found indications of a negative association between CEO extraversion and the firm's ability to take advantage of heightened volatility.

We hypothesized and confirmed that CEO conscientiousness and CEO neuroticism impede the firm's ability to exploit increased volatility. Are these findings of a causal nature or pure associations? We find it likely that CEO personality traits cause corporate outcomes in line with the reasoning of Roll (1986) in relation to corporate acquisitions. However, is such a causal explanation likely in the case of the firm's ability to exploit increased volatility? Plausibility is of utmost importance in a situation with an abundance of data and an abundance of degrees of freedom in terms of how to handle such data (Harvey, 2017). Could it be that CEOs are selected by the boards of directors partly based on the personality traits of the CEOs and the inherent (dis)advantages of these traits in the context of expected increases or decreases in volatility environments? We find such an explanation possible but not to an extent that it can explain our findings. Our median CEO has been in the position for 6 years (Table 1) and we are operating with monthly changes in volatility. We find it unlikely that the (potentially qualified) guesses of the boards of directors into future changes in volatility extend to more than a few quarters. If this reasoning is correct, the overwhelming majority of years support a causal story rather than a matching story.

Our findings have important practical implications in terms of CEO selection and CEO management. CEOs who are less conscientious and less neurotic will likely thrive in increasingly uncertain environments, whereas CEOs who are more conscientious and more neurotic tend to thrive in more stable environments. None of these findings relate to general performance outcomes, however. Our findings do not suggest that a specific CEO personality trait is universally good or bad. Rather, depending on the context and the environmental conditions, a firm may be selective in terms of the choice of CEO personality. A firm that faces heightened volatility – whether driven by external developments or a change in business strategy – may find it best to seek a CEO who is less conscientious and neurotic, whereas another firm operating in more calm waters might be more inclined to find a CEO who plans in detail and is eager to manage even small dangers. For the management of CEOs, the board of directors (and ultimately the shareholders) should be aware of the potential shortcomings certain CEO personality traits may entail in specific economic contexts and consider incentives accordingly. Finally, our results should be taken with some caution as we cannot rule out potential survivorship bias as firms with low strategic flexibility may not survive and may thus not appear in our sample.

Data availability

Data will be made available on request.

Acknowledgements

We are grateful to Harrison et al. (2019) for providing access to the Open Language Chief Executive Personality Tool (OLCPT) in R to estimate CEO Big Five personality traits. We appreciate research assistance from Toke Aabo and Marc Aabo. We thank seminar participants at Aarhus University and participants at the Southern Finance Association 2021 Annual Meeting and the 2nd Annual Boca Corporate Finance and Governance Conference for helpful comments and suggestions. Support from the Danish Finance Institute (DFI) is gratefully acknowledged. All remaining errors are our own.

Appendix A. Appendix

Variable descriptions

Variables	Descriptions
Firm characteristics	
Excess monthly return	Excess monthly return (raw return minus risk-free rate) in month m. Data sources: CRSP and Kenneth French's site (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html).
ΔVolatility	The change in volatility from the past month. We determine the volatility of the firm's equity by computing the standard deviation of its daily stock returns throughout the given month. To estimate the volatility of the firm's assets, we adopt a methodology from the literature on KMV distance-to-default measurement (e.g., Bharath and Shumway, 2008). Data sources: CRSP and Compustat.
Market factor loading	The estimated coefficient, beta, on daily market premiums in the market model of daily excess returns in month m. Data sources: CRSP and Kenneth French's site (https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html).
Book-to-market ratio	The ratio of book-value to market-value of equity. It is transformed by taking the natural log after adding 1. Data sources: Compustat and CRSP.
Size	Total equity. It is transformed by taking the natural log after adding 1. Data sources: Compustat.
Leverage	The ratio of total debt to total assets. Data sources: Compustat.
Previous return	6-month lagged return from month m-6 to m-1. Data sources: CRSP.
Dividend payout	The ratio of common and preferred dividends to net income. Data sources: Compustat.
Capital expenditures	The ratio of capital expenditures to sales. Data sources: Compustat.
Volume	The contemporaneous trading volume in month m adjusted by the number of common shares. Data sources: CRSP.
ROA	The ratio of net income to total assets. It is a quarterly measure. Data sources: Compustat.
Operating cash flows	The ratio of operating cash flows to total assets. It is a quarterly measure. Data sources: Compustat.
CEO characteristics	
CEO age	CEO age. It is transformed by taking the natural log after adding 1. Data sources: ExecuComp.
CEO tenure	The number of years the CEO has held the CEO position. It is transformed by taking the natural log after adding 1. Data sources: ExecuComp.
CEO gender	An indicator that takes 1 if the CEO is female and 0 otherwise. Data sources: ExecuComp.
CEO education	An indicator that takes 1 if the CEO has a master's or doctoral degree and 0 otherwise. Data sources: Bloomberg and various web sites.
CEO duality	An indicator that takes 1 if the CEO serves as the board chairman and 0 otherwise. Data sources: ExecuComp.
CEO salary and bonus	Salary and bonus scaled by total compensation. Data sources: ExecuComp.
CEO incentives	Unexercised options (exercisable + unexercisable) and restricted stock holdings scaled by total compensation. Data sources: ExecuComp.
CEO personality traits and biases	
CEO openness	The measure of CEO openness, which ranges from 1 (extremely low) to 7 (extremely high). Data sources: Conference calls (Factiva and Nexis Uni) and Open Language Chief Executive Personality Tool (OLCPT) in Harrison et al. (2019).
CEO conscientiousness	The measure of CEO conscientiousness, which ranges from 1 (extremely low) to 7 (extremely high). Data sources: Conference calls (Factiva and Nexis Uni) and Open Language Chief Executive Personality Tool (OLCPT) in Harrison et al. (2019).
CEO extraversion	The measure of CEO extraversion, which ranges from 1 (extremely low) to 7 (extremely high). Data sources: Conference calls (Factiva and Nexis Uni) and Open Language Chief Executive Personality Tool (OLCPT) in Harrison et al. (2019).
CEO agreeableness	The measure of CEO agreeableness, which ranges from 1 (extremely low) to 7 (extremely high). Data sources: Conference calls (Factiva and Nexis Uni) and Open Language Chief Executive Personality Tool (OLCPT) in Harrison et al. (2019).
CEO neuroticism	The measure of CEO neuroticism, which ranges from 1 (extremely low) to 7 (extremely high). Data sources: Conference calls (Factiva and Nexis Uni) and Open Language Chief Executive Personality Tool (OLCPT) in Harrison et al. (2019).

(*continued*)

Variables	Descriptions
CEO narcissism	The number of the singular pronouns divided by the sum of first-person singular pronouns and first-person plural pronouns in the CEO speech, which is obtained in the Q&A sessions of quarterly earnings conference calls. It is a continuous score between 0 (extremely non-narcissistic) and 1 (extremely narcissistic) per construction. Data sources: Conference calls (Factiva and Nexis Uni).
CEO overconfidence	An option-based overconfidence measure as in Malmendier and Tate (2005) and Campbell et al. (2011). CEO overconfidence is the value per exercisable option divided by the average strike price. The value per exercisable option is the total value of the exercisable but unexercised options divided by the number of those options. The average strike price is the average stock price at the time the option-value is determined minus the value per exercisable option. We use a cutoff rate of 67% for CEO overconfidence. CEO overconfidence is an indicator, which takes 1 from the first year in which CEO's overconfidence is greater than 67% in two or more years. Data sources: ExecuComp and CRSP

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