University of Southampton

Faculty of Social Science

Department of Finance and Banking, Southampton Business School

Powerful CEOs and Firm Risk Dynamics During Crises: Insights from Environmental Practices - An International Study

by

Hamad Abdulrahman Aldawsari

Supervisors:

Prof. Taufiq Choudhry
Dr. Saad Baloch

Thesis for the degree of Doctor of Philosophy

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Abstract

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This thesis consists of three independent empirical studies focusing on the impact of CEO power on different types of corporate risk. Each study incorporates unique themes as moderating factors, analysing how CEO power interacts with these factors to influence corporate risk.

The first paper investigates the relationship between CEO power and firm risk at the onset of the global financial crisis 2007 and the COVID-19 pandemic health crisis 2020. An international sample of publicly listed firms in the G7 nations between 2006 and 2021 shows that CEOs with greater power are exposed to higher risk than firms led by CEOs with lesser power. The result is primarily driven by the impact of CEO power on idiosyncratic risk rather than systematic risk. Further, we found that powerful CEOs tend to be more cautious and conservative during crises, as seen in the pandemic, where the positive power–risk relationship is less pronounced. Nevertheless, the power–risk relationship remains unchanged during the more familiar financial crisis. This study has important implications for firms, investors, regulators, and policymakers.

The second paper examines how CEO power affects firm tail risks globally and whether such an effect varies during crisis periods by examining a sample of 12,761 firm-year observations from

G7 nations from 2006 to 2021. Based on the difference-in-difference (DiD) model, it is shown that CEOs with greater power and control over the company maintain the exercise of their power similarly during regular and difficult operating periods. Furthermore, the findings are mainly driven by non-financial firms and firms with low R&D expenditure, indicating their risk-taking capacity. Thus, we find that companies with more powerful CEOs are exposed to higher tail risks than those with less powerful CEOs. This holds for both idiosyncratic and systematic tail risk. During crises such as the financial crisis of 2007 and the recent COVID pandemic, the impact of CEO power on tail risk remains relatively unchanged. Our research provides valuable insights for policymakers, investors, regulators, and firms, including CEOs, to better manage risks in the future.

The third paper investigates the influence of CEO power on corporate stock price crash risk in an international setting, alongside the moderating impacts of corporate environmental practices on such a relationship. Two environmental practices are examined: greenhouse gas (GHG) emissions and Sustainable Development Goal 13 (SDG-13 supporting climate action). Analysing data from publicly listed firms in the G7 nations from 2006 to 2021, we discover that firms led by more powerful CEOs are generally exposed to lower crash risks. Additionally, we found that companies implementing more robust environmentally friendly practices, particularly supporting climate actions SDG-13, see a further reduced crash risk. This pattern is especially evident in non-crisis periods, non-financial firms and firms with high environmental and social (ES) scores, i.e., CSR performance. The findings are assured by various robustness tests using alternative estimation models, alternative measures, and additional tests.

Keywords: CEO power; firm risk; tail risk; stock price crash risk; financial crisis; COVID-19 pandemic; environmental; SDG13; GHG emission

Contents

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Research Thesis: Declaration of Authorship

Print name: Hamad Abdulrahman Aldawsari

Title of thesis: Powerful CEOs and Firm Risk Dynamics During Crises: Insights from Environmental Practices - An International Study

I declare that this thesis and the work presented in it are my own and have been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission.

Signature: Date:02/07/2024

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Chapter 1

1. INTRODUCTION

As the preeminent corporate decision-makers, Chief Executive Officers (CEOs) play a crucial role in firms' strategic direction and risk management. Their responsibilities involve various strategic and operational duties, including managing, reviewing, and revising organisational structures, maintaining stakeholder relationships, and, most importantly, controlling, assessing, and evaluating firm risk levels (Finkelstein & Boyd, 1998). Decision-making involves a trade-off between feasible alternatives to achieve a strategic goal, solve issues, and avoid potential risks (Von Neumann & Morgenstern, 1944). Due to the magnitude of risk-based decisions, this is one of the significant roles of CEOs. Several studies (Bezzina et al., 2014; Marks, 2011; Stulz, 2008; Power, 2007; Teschner et al., 2008; Adam et al., 2015; Jarrow & Turnbull, 2000; Jarrow, 2008) define risk management as the process of identifying, managing, and mitigating risks in an organisation. Bezzina et al. (2014) define risk as potential unexpected (adverse) events that have not yet happened. Therefore, risk management is essential for maintaining a company's financial stability, operational continuity, and long-term growth. It is closely tied to the outcomes of CEO decisions, which can also be potential risk factors for the company. Therefore, CEOs must skillfully manage risks to optimise the company's performance by weighing internal and external risks against prospective benefits. The role of CEOs also significantly influences a company's overall operations and strategic choices (Grinstein & Hribar, 2004; Lewellyn & Muller-Kahle, 2012; Sheikh, 2019), especially in the context of risk management (Fernandes et al., 2021; Pathan, 2009; Sheikh, 2019; Lewellyn & Muller-Kahle, 2012; Shahab et al., 2020). Given the importance of CEO power and corporate decision-making subjects, the thesis examines how CEO power influences different risk aspects of firms employing an international sample from 2006 to 2021, especially in times of crisis, such as during the 2007 financial collapse and the recent COVID-19 pandemic.

Since the 2007 global financial crisis, risk management has been a fundamental topic in the media, as noted by Huber and Scheytt (2013). Interest in risk management grew for 20 years before the crisis and has become a common topic in both academic and professional discussions, showing how widespread it is (Huber & Scheytt, 2013). Policymakers now focus on creating rules to oversee how companies take risks, especially during crises (Sheikh, 2019). The financial crisis of 2007 and the COVID-19 pandemic of 2020 are seen as major risks to the global economy, much like the Great Depression from 1929 to 1932 (Moschonas, 2020). These events have shown how vulnerable the global economy is and how it affects company risk-taking. Therefore, it is more important than ever to keep studying what drives company risk today.

The exploration of corporate governance is central to the discussions of the power held by CEOs and the hierarchy within the examined companies. CEO power has been claimed to be a critical determinant of corporate strategic decisions and outcomes (Grinstein & Hribar, 2004; Lewellyn & Muller-Kahle, 2012; Sheikh, 2019), although it is not a characteristic that can be directly observable (Liu & Jirapor, 2010). In this thesis, the main proxy of CEO power employed is the CEO Pay Slice (CPS), which measures the CEO's relative compensation among top executives. It captures the CEOs' relative significance in the management team in terms of their contribution, power, and ability; it has been claimed to be a more objective, useful, and advantageous measure in comparison to others due to its ability to capture "the relative centrality of the CEO in the top management team" (Liu & Jiraporn, 2010, p. 748; Finkelstein, 1992) as well as its strong explanatory power for a firm's corporate outcomes (Bebchuk et al., 2006 and Bebchuk, Cohen, and Ferrell, 2009). The debate of whether conferring significant power to a CEO is beneficial to corporations continues to resonate within corporate governance practices. Critics, such as Bebchuk et al. (2002), argue that excess power may motivate them to seek personal gains over stakeholder interests. This concern prompts an examination of the potential risks and benefits associated with powerful corporate leadership. This research is particularly motivated by the ongoing discourse surrounding the ramifications of this power dynamic. A preliminary analysis of related literature reveals that authority to a CEO demands vigilant oversight from the board of directors (Combs et al., 2007). This oversight is crucial to ensure that the empowerment of CEOs aligns with the broader goals and ethical standards of the corporation.

Additionally, the thesis comprises three empirical studies holding the same theme on CEO power and corporate risk, as mentioned above. The first study examines the relationship between CEO power and firm risk at the onset of the global financial crisis 2007 and the COVID-19 pandemic health crisis in 2020. The second study investigates how CEO power is associated with firm tail risks on a global scale and whether such an association varies during crisis periods. The third study examines the relationship between CEO power and corporate stock price crash risk in an international setting, alongside the moderating impacts of corporate environmental practices on such a relationship.

Although the three studies cover the same theme, each focuses on a different risk aspect, which is relevant for corporations. Particularly, the first study focuses on the final/general risk level of firms. Various studies investigate the risk level of a firm, which can be most widely measured by stock volatility (Sheikh, 2019). This risk aspect captures the total risk embedded in the fluctuation of firm stock price and is the risk outcome of firms' risk-taking behaviours. Despite its importance and relevance, this risk level is a double-edged sword, so higher risk is not necessarily a bad outcome. According to the risk-return framework of Markowitz (1952), the higher risk goes in hand with a higher return. Given the risk-taking nature of shareholders who generally possess diversified investment portfolios, a higher risk level can yield higher returns, increasing the shareholders' values and achieving the core corporate objective (Gong, 2004; Jensen & Meckling, 1976).

The second study focuses on tail risk and applies an entirely different aspect of risk, specifically, an inferior and suboptimal risk, i.e., tail risk. Tail risk captures the heavy-left tail of the probability distribution of the stock returns to observe the likelihood and occurrence of highly adverse outcomes (Diemont et al., 2016). Tail risk is considered excessive risk resulting from CEOs' inappropriate decisions (Bushman et al., 2018; Trinh et al., 2022; Trinh et al., 2023). Furthermore, Ellul (2015) noted that tail risk is an uncommon/extreme outcome that impacts institutional investments undesirably. Thus, investors are concerned with tail risk due to its subsequential extreme stock price decreases (Cohen et al., 2014). For instance, to a great extent, the financial crisis 2007 was amplified due to tail risk (Cohen et al., 2014). As such, in almost all circumstances, investors dislike and avoid corporations with higher tail risk (Hocquard & Papageorgiou, 2013).

The last study extends the examination to the stock price crash risk. The concern around stock price crash risk has been amplified in recent years, highlighted by numerous studies pointing out the dangers of accumulating negative information (Kothari et al., 2009; Jin & Myers, 2006; Habib et al., 2018; Chen et al., 2021). The build-up of negative news resulted in the collapse of the stock price (Jin & Myers, 2006). Moreover, CEO power is identified as a contributing factor to increased crash risk. Al Mamun et al. (2020) and Tan and Liu (2016) highlight how powerful CEOs may conceal negative information, leading to greater vulnerability to stock price crashes. Therefore, stock price crash risk differs from firm and tail risks. Stock price crash risk pertains to the sudden, sharp drop in a stock price, typically caused by the release of previously hidden negative information, highlighting issues of information asymmetry. Firm risk focuses on the final/general risk level of firms; this risk level is a double-edged sword, and a higher risk is not necessarily a bad outcome. Tail risk is rare and viewed as the excessive risk that results from CEOs' inappropriate decisions (Bushman et al., 2018; Trinh et al., 2022; Trinh et al., 2023). Furthermore, the last study considers a non-financial aspect of the firm as a moderator, i.e., the greenhouse gas emission. Environmental practices of firms as moderating factors, including GHG emission levels and SDG-13 goal, may shed light on the contexts and mechanisms through which corporate social responsibility and sustainability efforts could impact the CEO power-crash risk relationship. This paragraph explains the differences across the three studies to highlight their relevancy.

Study 1 aims and objectives:

a) Investigate the relationship between CEOs' power and firm risk-taking.
b) Investigate the moderating effect of the COVID-19 crisis on such relationship***s***.

Study 2 aims and objectives:

a) Investigate the relationship between CEOs' power and firm tail risk.
b) Investigate the moderating effect of the COVID-19 crisis on such relationship***s***.

Study 3 aims and objectives:

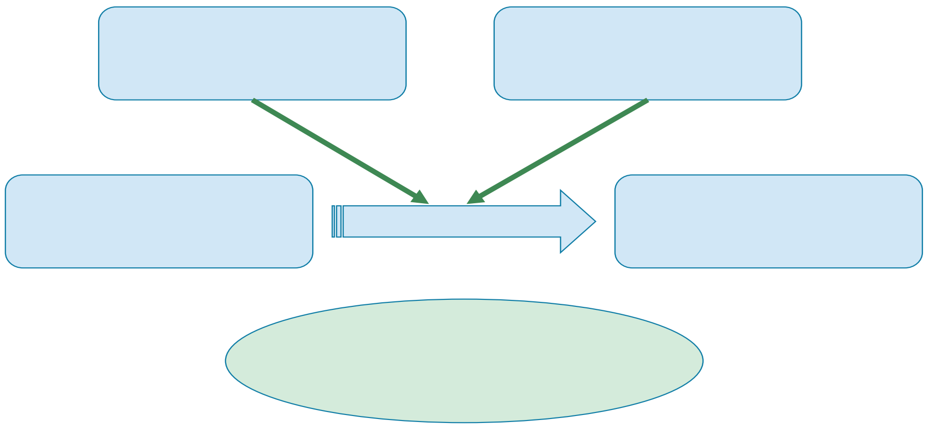
a) Investigate the relationship between CEOs' power and stock price crash risk.
b) Investigate the moderating effect of environmental practices on such a relationship.

The thesis brings a valuable perspective on the roles and responsibilities of G7 corporate leaders in steering the global economy toward a sustainable and resilient future. The G7 group includes seven of the most advanced economies—Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States- significantly supporting the world economy. These seven countries collaborate closely to address complex global issues, ranging from economic stability to security challenges, thereby profoundly shaping the international landscape. This thesis examines the G7's critical contributions to global economic governance, security, and energy policies, emphasising the importance of their united efforts in fostering global development and stability (Paletta et al., 2019; Gymfi et al., 2021; Nitsch et al., 2007).

a. *FIRST PAPER: POWERFUL CEO AND FIRM RISK AT THE ONSET OF THE FINANCIAL CRISIS 2007 AND THE COVID-19 HEALTH CRISIS: AN INTERNATIONAL EVIDENCE*

i. Aims

Building on the limited and inconclusive research about the link between CEO power and firm risk, this study explores the international relationship amid economic, financial, and health turbulence.



ii. Objectives

The objective of this study is to investigate the impact of CEO power on firm risk, using an Ordinary Least Squares (OLS) model as the baseline and employing various robustness checks such as fixed effects models, lagged approach, Generalized Method of Moments (GMM), and Two-Stage Least Squares (2SLS) to address potential endogeneity issues. The study also incorporates alternative dependent and independent variables to validate the findings. Additionally, it aims to analyse the effects of financial and COVID-19 crises on the CEO power-firm risk relationship through Difference-in-Differences (DiD) analyses with interaction terms and propensity score matching (PSM). Subsample analyses using Chow's test are conducted to assess variations across groups or periods and deepen the understanding of this relationship internationally amid economic, financial, and health crises.

iii. Motivation and background

Risk management has resonated significantly in the media throughout and beyond the 2007 global financial crisis (Huber & Scheytt, 2013), with its importance progressively growing over the two decades preceding the crisis. Discussions about risk and how to manage it are now common in academic studies and among professionals in the field, showing that these practices are widely used (Huber & Scheytt, 2013). Accordingly, policymakers constantly attempt to develop conditions that impose requirements to monitor firm activities involving risk (Sheikh, 2019), specifically during crises. The financial crisis of 2007 and the pandemic of 2020 are considered the riskiest events to impact the world's economy since the Great Depression of 1929-1932 (Moschonas, 2020). In this regard, both events revealed the global economy's vulnerability and impact on firms' risk-taking.

Therefore, the motivation for this research stems from a notable gap in the literature regarding the effects of CEO power on firm risk-taking, particularly in the context of global economic fluctuations and crises such as the 2007 financial meltdown and the COVID-19 pandemic.

iv. Research questions:

1- Is there a significant relationship between CEOs' power and firm risk-taking?

2- Is the relationship between CEOs' power and firm risk-taking different in financial, non-financial, COVID, and non-COVID crises?

v. Contributions

This study has two main contributions. First, previous research on the connection between CEO power and corporate risk was limited to single-country studies, making their findings applicable mainly to firms operating within that specific region. However, this study used a global sample from G7 countries, enhancing the generalisability and relevance of the results across multiple regions. Second, it exploits the most current data from 2006 to 2021, covering significant events like the COVID-19 pandemic and various updates in global governance codes. This period also includes the 2007 financial crisis and the 2020 COVID-19 health crisis, which have rarely been analysed in earlier studies. The findings will thus provide insights into whether the relationship between CEO power and firm risk remains consistent, strengthens, or weakens during different kinds of economic upheavals, thereby confirming and building upon the results of prior research.

vi. Data

The study applies a cross-country panel data sample of publicly listed companies from the G7 countries: the United States, the United Kingdom, Germany, France, Italy, Canada, and Japan. It spans from 2006 to 2021 and includes 12,836 firm-year observations, marked by the global financial crisis of 2007 and the COVID-19 health crisis. Financial and accounting data for these firms were sourced from the Refinitiv Datastream database. Governance-related information, including board compensation and CEO characteristics, was collected from the WRDS BoardEx database. Additionally, to minimise the influence of outliers, all financial variables are winsorised at the 1st and 99th percentiles, following the method suggested by Kim and Lu (2011).

vii. Method

In this study, we investigate the influence of CEO power on firm risk using an Ordinary Least Squares (OLS) model, complemented by various robustness checks to confirm the results from the baseline model. These robustness checks include fixed effect models, the lagged approach, the Generalized Method of Moments (GMM), and Two-Stage Least Squares (2SLS), all aimed at addressing potential endogeneity issues. Additionally, alternative dependent and independent variables are incorporated to validate the findings further.

To specifically analyse the impacts of the financial and COVID-19 crises on the relationship between CEO power and firm risk, the study employs Difference-in-Differences (DiD) analyses with interaction terms and DiD with the propensity score matching (PSM) method. We also conduct analyses on different subsamples using Chow's test to examine whether the effects vary across different groups or periods, as Contessi et al. (2014) outlined.

viii. Findings

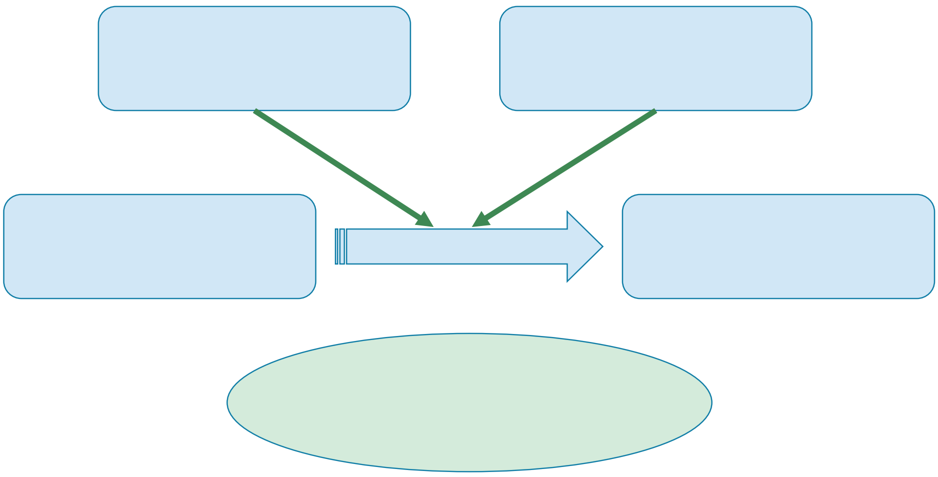
The findings of this study reveal that CEO power is positively linked to firm risk. Specifically, a 1% increase in CEO power is associated with a 10% rise in the firm's total risk. This relationship is primarily driven by the impact of CEO power on firm-specific risk rather than market-based risk from the economic significance perspective.

Moreover, the relationship between CEO power and firm risk becomes less evident during economic instability, such as during the financial and global health crises. This diminished relationship may be attributed to the heightened caution among CEOs amid uncertainties. Even those with considerable institutional power may adopt more conservative strategies during turbulent times. Consequently, optimism, confidence, and risk error judgment are all lower than usual, leading to lower risk levels.

b. SECOND PAPER: FALLING IN TURBULENCES: EFFECTS OF CEO POWER ON EXTREME TAIL RISK ON G7 COUNTRIES

i. Aims

This study aims to fill the literature gap concerning the relationship between CEO characteristics and firm tail risk by investigating the link between CEO power and firm tail risk and its impact during financial and health turbulence periods.



ii. Objectives

The objective of this study is to examine the relationship between CEO power and firm tail risk, employing a baseline Ordinary Least Squares (OLS) model alongside multiple robustness checks such as lagged approaches, fixed and random effects models, System Generalized Method of Moments (GMM), and 2-stage least squares (2SLS) to address potential endogeneity. The study further incorporates models with alternative dependent and independent variables to validate the findings. Additionally, it explores the effects of financial and COVID-19 crises on this relationship using Difference-in-Differences (DiD) with interaction terms, DiD with propensity score matching (PSM), and subsample analysis with Chow's test. Focusing on CEO power and its association with firm tail risk during periods of financial and health turbulence, the study aims to fill a gap in the literature regarding the impact of CEO characteristics on firm risk.

iii. Motivation and background

According to Eisenkopf, Juranek, and Walz (2023), the emergence of COVID-19 in early 2020 was particularly severe, distinguishing it from past crises due to its health-related nature. This pandemic triggered significant economic and financial challenges, necessitating unprecedented responses from institutions and governments. The actions and decision-making of senior corporate managers during this health crisis remain under-researched areas.

Our study is driven by the need to explore the potential for CEOs to exert their power during crises. The study aims to investigate whether such power could lead to adverse outcomes for firms, specifically, a surge in tail risk. This type of risk, characterised by a drastic drop in a company's stock return, is a critical indicator of shareholder reactions, including mass retirements of their stock holdings during turbulent times. Such extreme reactions can harm a firm's survival, underscoring the urgency of understanding the factors that influence them. In this study, we examine the impact of CEO power on tail risk using an international sample across the financial crisis of 2007 and the COVID-19 crisis of 2020.

iv. Research questions:

1- Is there a significant relationship between CEOs' power and firm tail risk?

2- Is the relationship between CEO power and firm tail risk-taking different in financial, non-financial, COVID-19, and non-COVID-19 crises?

v. Contributions

The study makes three significant contributions to CEO characteristics and firm tail risk literature. First, prior studies examined the relationship between CEO characteristics and firm tail risk and only focused on CEO attributes such as materialism, forced turnover, and gender (e.g., Bushman, Davidson, Dey, and Smith, 2018; Srivastav et al., 2017; Wang & Fung, 2022). To the best of our knowledge, we are the first to conduct a study examining the relationship between CEO power and firm tail risk. Second, unlike prior studies that only focus on a single country in their examinations (e.g., Bushman, Davidson, Dey, and Smith, 2018; Wang & Fung, 2022), our study employed an international sample of G7 countries. Therefore, findings are more generalisable and relevant in a broader context. Thirdly, it employs a contemporary dataset covering 2006 to 2021, a period marked by significant events such as the COVID-19 pandemic and financial crises, thus providing a comprehensive base for evaluating the influence of CEO power during varied global conditions.

vi. Data

This study analyses a comprehensive dataset of publicly listed companies from the G7 countries: the United States, the United Kingdom, Germany, France, Italy, Canada, and Japan. The timeframe of the investigation extends from 2006 to 2021, capturing 12,761 firm-year observations. This period includes significant economic events such as the 2007 global financial crisis and the ongoing COVID-19 pandemic. The research draws on accounting and financial data sourced from the Refinitiv Datastream database. Additionally, details on board compensation and CEO characteristics are collected from the WRDS BoardEx database. Financial variables are winsorised at the 1st and 99th percentiles to minimise the effects of statistical outliers, following the methodology proposed by Kim and Lu (2011).

vii. Method

In this study, we investigate the influence of CEO power on tail risk using a baseline Ordinary Least Square (OLS) model complemented by multiple robustness checks to validate the findings from the initial analyses. We incorporate several alternative methodologies, including the lagged approach, fixed and random effects models, the System General Method of Moments (GMM), and the 2-stage least squares (2SLS) approach, also known as the instrumental model. Additionally, we explore models with different dependent and independent variables (Trinh et al., 2023; Milidonis et al., 2019; Li et al., 2023; Lewellyn & Muller-Kahle, 2012; Arena et al., 2017). To assess the impacts of the financial and COVID-19 crises on this relationship, we use Difference-in-Differences (DiD) with interaction terms, DiD combined with propensity score matching (PSM), and analysis on various subsamples using Chow's test (Contessi et al., 2014).

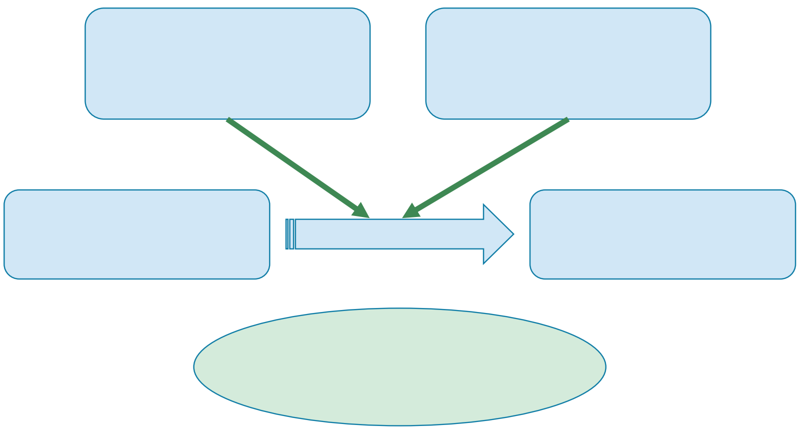
viii. Findings

Our baseline model shows that CEO power is significantly and positively associated with tail risk. We further separate tail risk into idiosyncratic tail risk (ES-Idio) and systematic tail risk (ES-Sys), finding that CEO power significantly enhances both forms of risk—those emanating from firm-specific factors and those arising from market-wide factors. Using the Difference-in-Difference (DiD) methodology, we observe that the link between CEO power and corporate tail risk remains consistent across different crises, including financial and health-related crises. This pattern is held in statistical tests for both the DiD with interaction terms and the DiD with propensity score matching (PSM) methods. Our findings suggest that CEOs with greater power are likely to take on excessive risks, thereby increasing tail risk in both stable and volatile economic and financial conditions.

c. *THIRD PAPER: INTERNATIONAL EVIDENCE ON THE CEO POWER AND STOCK PRICE CRASH RISK: MODERATING EFFECT OF ENVIRONMENTAL PRACTICES*

i. Aims

This research extends the limited and inconclusive existing literature on the link between CEO power and stock price crash risk. Furthermore, this study aims to address the research gap, explore the moderating effects of greenhouse gas (GHG) emissions, and support Sustainable Development Goal 13 (SDG-13) on this relationship. The study aims to clarify how environmental factors and CEO authority might interact to impact stock price crash risk.



ii. Objectives

The objective of this study is to investigate the relationship between CEO power and stock price crash risk, employing a baseline Ordinary Least Squares (OLS) model along with various robustness checks, including fixed/random effects, system General Method of Moments (GMM), 2-stage least squares (2SLS), lagged dependent variables, Weighted Least Squares (WLS), and models with alternative independent and greenhouse gas (GHG) emission variables. By addressing the research gap in the limited and inconclusive literature, the study also aims to explore the moderating effects of GHG emissions and support for Sustainable Development Goal 13 (SDG-13) on this relationship, providing insight into how environmental factors and CEO power interact to influence stock price crash risk.

iii. Motivation and background

Building on the previous studies' exploration of CEO power, this study focuses on another critical risk: stock price crash risk. While the other studies addressed risk level and tail risk, stock price crash risk is imperative for firms to manage due to its severe consequences. This risk arises when managers hoard bad news, leading to an eventual public disclosure that causes adverse reactions from shareholders and a significant fall in firm value.

Furthermore, in recent decades, the environmental dimension has become increasingly critical due to the growing threat of climate change (Henisz et al., 2019). As a result, governments, regulatory bodies, and international organisations are pushing for companies to align executive incentives with greenhouse gas (GHG) reduction goals to combat pollution and global warming (Al-Shaer & Zaman, 2019; Haque & Ntim, 2020). For instance, the United Nations (UN) supports developing countries through Sustainable Development Goal 13 (SDG-13), which focuses on climate action to mitigate impacts and encourage low-carbon growth. This initiative aims to achieve two primary objectives: reducing the global temperature increase to 1.5°C and cutting carbon dioxide emissions to less than 45% by 2030, with a target of net zero by 2050 (Küfeoğlu, 2022). This study further examines the role of two environmental practices—corporate GHG emissions, which indicate the level of pollution a firm produces, and corporate support for SDG-13—as moderating factors in the relationship between CEO power and stock price crash risk.

iv. Research questions:

1- Is there a significant relationship between CEO power and stock price crash risk?

2- Do stronger environmental practices (lower GHG level and SDG-13 support) significantly moderate the relationship between CEO power and stock price crash risk?

v. Contributions

This study addresses two key aspects of the relationship between CEO power and stock price crash risk within an international context. Firstly, it investigates this relationship across the G7 nations, which provides a broader, more generalisable setting compared to prior research that has often focused on single-country studies, thereby limiting the applicability of their findings beyond specific national contexts (Al Mamun et al., 2020; Shahab et al., 2020; Kalia, 2024). The use of an international sample from the G7 countries enhances the generalizability of this study results across diverse environments.

Secondly, the research investigates the moderating effects of corporate environmental practices on this relationship. It examines explicitly two practices: greenhouse gas (GHG) emissions and support for Sustainable Development Goal 13 (SDG-13), which advocates for climate action. This study aims to fill the research gap and clarify the uncertainty surrounding how GHG emissions and SDG-13 support might influence the dynamics between powerful CEOs and stock price crash risk. It provides empirical evidence to contribute to the ongoing debate on how corporate social responsibility (CSR) engagement affects transparency and the hoarding of bad news by powerful executives, particularly during both stable and volatile macroeconomic periods.

vi. Data

This research is significant as it leverages data from publicly listed companies in the main economies of the G7 nations. This group includes the USA, the UK, Germany, France, Italy, Canada, and Japan. The dataset spans from 2006 to 2021, a period marked by significant global events such as the 2007 financial crisis and the 2020 COVID-19 pandemic. The study utilises comprehensive data from the Refinitiv Datastream database, encompassing accounting and financial information and daily stock market prices used to compute stock price crash risk and environmental-related variables. Additionally, data on board compensation and CEO characteristics are sourced from the WRDS BoardEx database. Macroeconomic variables are gathered from various sources, including the World Bank and the International Monetary Fund databases, enhancing the robustness of the analysis. The final dataset that forms the basis of this study captures a significant 11,189 firm-year observations. Moreover, all financial variables are winsorised at the 1st and 99th percentiles to mitigate the impact of outliers (Kim & Lu, 2011). This approach ensures a comprehensive analysis, aiming to provide insightful findings on the interplay between CEO power, environmental practices, and stock price crash risk across different economic contexts.

Methodologically, we utilised a baseline Ordinary Least Squares (OLS) model, bolstered by a range of robustness checks, to validate our initial findings. These checks included the application of alternative models such as additional variables, fixed/random effects, the system General Method of Moment (GMM), the 2-stage least square (2SLS) approach (or instrumental model), lagged dependent variable, and Weighted Least Square (WLS). We also experimented with models featuring alternative independent and GHG emission variables.

vii. Findings

Our research, which employs various estimation models, including Ordinary Least Squares (OLS) regressions complemented by robustness checks, is significant in that it examines the impact of CEO power on stock price crash risk and explores how different environmental practices influence this relationship. The findings reveal that firm crash risk, as indicated by measures such as DUVOL and NSKEW, significantly decreases with an increase in CEO power. However, during turbulent periods, such as financial and health crises, the relationship between powerful CEOs and firm crash risk generally appears indifferent.

Furthermore, the study finds that the observed results are predominantly evident in non-financial firms and those with high Corporate Social Responsibility (CSR) performance, as measured by high Environmental and Social (ES) scores. The results suggest that the mitigating effect of Sustainable Development Goal 13 (SDG-13) on the relationship between CEO power and crash risk is most pronounced during non-crisis periods. In crisis times, the impact of CEO power on reducing crash risk is not significant, as indicated by the non-significant coefficients of CPS. This underscores the intricate and multifaceted nature of CEO influence on firm stability, particularly under varying economic conditions and environmental commitments.

Chapter 2: POWERFUL CEO AND FIRM RISK AT THE ONSET OF THE FINANCIAL CRISIS 2007 AND THE COVID-19 HEALTH CRISIS: AN INTERNATIONAL EVIDENCE

Abstract

We investigate the relationship between CEO power and firm risk at the onset of the global financial crisis 2007 and the COVID-19 pandemic health crisis in 2020. Examining an international sample of publicly listed firms in the G7 nations from 2006 to 2021, we found that companies with more powerful CEOs face higher risks than those with less powerful CEOs. The result is primarily driven by the impact of CEO power on idiosyncratic risk (firm risk) rather than systematic risk (market risk). Further, we find that powerful CEOs tend to be more cautious and conservative during crises they have no reference for or experience, as in the case of the pandemic, during which the positive power-risk relationship is less pronounced. Nevertheless, the power-risk relationship remains relatively unchanged during the more familiar financial crisis. This study has important implications for firms, investors, regulators, and policymakers.

Key Words: CEO power; Risk-taking; Financial crisis; COVID-19 pandemic

1. INTRODUCTION

Chief executive officers (CEOs), the highest-level decision-makers in corporations, are responsible for a range of strategic duties. These include strategic operations and planning decisions, managing, reviewing, and revising organisational structures, managing productivity and profitability, communicating and maintaining stakeholder relationships, and, most importantly, controlling, assessing, and evaluating risk levels. Risk management is a fundamental aspect that directly influences firms' financial performance, survival, and long-term growth. CEOs are the agents that carry full responsibility for this.

According to the risk-return framework of Markowitz (1952), higher risk is compensated for by potentially higher return. This implies that a higher risk level is not necessarily a suboptimal outcome if it yields better returns that assist in shareholder wealth maximisation as an objective. On the other hand, firms acting conservatively through carrying too little risk can irritate shareholders, who are often viewed as risk-seeking principals. Conservative managers may forgo value-enhancing but risky projects and commit to safer yet value-damaging investment strategies. Consequently, the CEO-level risk management role is indeed challenging and effort-provoking.

Given the significance, whether and how CEO characteristics impact firm risk-taking and firm risk outcomes have attracted extensive interest from both academic researchers and practitioners over recent decades (e.g., Çolak & Korkeamäki, 2021; Brisley et al., 2021; Fan et al., 2021; Neyland, 2020; Serfling, 2014). Among the many CEO role characteristics, the institutional power they possess particularly influences a firm's overall operations and strategic decisions (Grinstein & Hribar, 2004; Lewellyn & Muller-Kahle, 2012; Sheikh, 2019), and especially firm risk (Fernandes et al., 2021; Pathan, 2009; Sheikh, 2019; Lewellyn & Muller-Kahle, 2012). Extending the limited and inconclusive literature on the relationship between CEO power and firm risk, this study aims to investigate this relation on an international scale and in the face of economic, financial, and health turbulence.

This study employs a cross-country panel data sample containing publicly listed firms in the G7 countries: the United States, United Kingdom, Germany, France, Italy, Canada, and Japan. The investigation covers a period from 2006 to 2021 with 12,836 firm-year observations. This period saw the global financial crisis 2007 and the COVID-19 health crisis. The G7 members represent more than 60% of the world's net wealth and around 50% of the world's gross domestic product (Climate Transparency, 2018). The considerable population sizes and solid economies give an advantage to the participating G7 members to be critical players in global markets and maintain solid political, environmental, economic, cultural, and diplomatic relations to strengthen their economic situations and support the world's weaker economies, given the availability of the means of production and manpower within their borders.

The relationship between CEO power and firm risk is built on behavioural agency theory (Wiseman and Gomez-Mejia, 1998) and the approach/inhibition theory of power (Keltner et al., 2003). The former enhances the agency-based model (Wiseman & Gomez-Mejia, 1998) by suggesting that executives are not solely risk-averse agents but can also exhibit risk-seeking attitudes and behaviours. Together with this view, the approach/inhibition model conceptualises that executives with power tend to act following their behavioural approach system, triggering them to focus more on positive outcomes, such as winning, achievements, and rewards (Magee & Galinsky, 2008; Keltner et al., 2003). Indeed, the social psychology literature strongly supports the idea that CEO power is associated with higher risk-taking decisions as they are more optimistic and exposed to higher judgment errors in their risk evaluation (Adams et al., 2005; Sah & Stiglitz, 1991; Anderson & Galinsky, 2006). Consequently, firms led by more powerful CEOs are expected to have higher risk levels than those led by less powerful CEOs, indicating a positive relationship. Empirically, the studies of Sheikh (2019) and Lewellyn and Muller-Kahle (2012) support this view, using non-financial and non-banking samples.

Throughout and beyond the global financial crisis of 2007, risk management has received a crucial echo in the media (Huber & Scheytt, 2013), with interest in it gradually increasing through the 20 years leading up to the financial crisis. Both instrumental and social discussions of risk and risk management practice have overwhelmed academic journals and non-academic content published by practitioners, indicating that the practice has become ubiquitous (ibid.). Accordingly, policymakers constantly attempt to develop conditions that impose requirements to monitor firm activities involving risk (Sheikh, 2019), specifically during crises. The financial crisis of 2007 and the pandemic of 2020 are considered the riskiest events to impact the world's economy since the Great Depression of 1929-1932 (Moschonas, 2020). In this regard, both events have revealed the global economy's vulnerability and its impact on firms' risk-taking. Therefore, it is necessary to continuously reassess the determinants of firm risk today more than ever.

The topic of CEO power and corporate risk during and after both the financial and COVID-19 crises are important for different reasons. First, financial and global health crises can have dramatic economic and social impacts, such as job losses and economic hardship. Thus, understanding the relationship between CEO power and corporate risk-taking can determine the required effort to reduce risk-taking and mitigate the impact of crises. Second, financial and global health crises can significantly impact investors. Research on CEO power and corporate risk can help shape investment decisions. Third, financial and global health crises can dramatically impact corporate leaders. For instance, studies have shown that firms with more powerful CEOs are more likely to engage in risky behaviours (Sheikh, 2019), which may result in negative consequences during a crisis. Hence, understanding the relationship between CEO power and corporate risk can provide insight into corporate leaders' decisions to implement strategies that balance CEO power to alleviate risk and improve their firms' resilience during a crisis. Our research provides valuable insights that can empower corporate leaders to make informed decisions and implement strategies that balance CEO power to alleviate risk and improve their firms' resilience during a crisis.

In this paper, we delve into the impact of CEO power on firm risk. We apply a baseline Ordinary Least Square (OLS) with various robustness checks to corroborate the findings obtained from the baseline methods. These include the fixed effect model, the lagged approach, the generalised method of moments (GMM), and 2SLS to account for endogeneity issues, as well as models with alternative dependent and independent variables. Furthermore, to investigate the effects of the financial and COVID-19 crises on the relationship, we employ the difference in differences (DiD) method and models on different subsamples with Chow's test (Contessi et al., 2014). The results we present indicate that CEO power is positively associated with firm risk. Particularly, when CEO power increases by 1%, the firm's total risk increases by approximately 10%. This relationship is mainly driven by the influence of CEO power on firm-specific risk rather than on market-based risk from the economic significance perspective. Furthermore, the relationship between CEO power and firm risk is less pronounced during times of turbulence, namely both financial and global health crises. This may be because, with uncertainty, CEOs tend to be more cautious, even when they possess great institutional power. Our findings shed light on the dynamics of CEO power and firm risk, providing a deeper understanding of corporate governance and risk management.

The contributions of this study are thus twofold. First, extant studies on CEO power and corporate risk have been conducted in a single country. This means that the findings are likely to apply specifically to firms that operate there. Extending the research stream, the current study is conducted on an international sample from G7 countries to make the findings more generalisable and relevant to a broader context. Second, this study employs the most updated dataset for the period between 2006 and 2021, which is important after a series of market-impacting events like the COVID-19 pandemic and the many related changes in governance codes around the globe. Furthermore, the chosen investigated timeframe includes both the financial crisis of 2007 and the COVID-19 health crisis of 2020. These two are barely assessed this way and have never been juxtaposed in relevant previous studies. Thus, the results of this study will indicate whether the relationship between CEO power and firm risk is either unaffected, stronger, or weaker in different types of turbulence. As such, they will confirm and extend the results of relevant previous studies.

Results obtained conclude that CEO power is significantly positively correlated with firm risk. The study also finds that the relationship between CEO power and risk is stronger in non-crisis periods. This suggests that power may allow and incline CEOs to take more risks in times of financial stability and discourage them (or at least encourage caution) from taking risks during crises. A distinction is made between the 2007 global financial crisis and 2020 COVID crisis. Particularly, the increased risk with CEO power remains relatively unchanged across financial and non-financial crises. However, such an effect only remains during non-COVID crises and disappears during COVID crises. This may be because the optimism and confidence of powerful CEOs are reduced during turbulence that they are unfamiliar with and have no reference to or experience of, which was the COVID case. Conceivably, CEOs with power are more reluctant to increase firm risk during new or ‘strange’ occurrences like a pandemic.

This study has important implications for firms, investors, regulators, and policymakers. For instance, policymakers can proactively use evidence from this study as a tool to anticipate the impact of crises on investors and markets by analysing how CEO power affects corporate risk. Regulators may establish improved rules and regulations to minimise risk and prevent future turbulence. Based on the recommendations, firms and investors can get deeper insights into managing the risks associated with powerful CEOs. This study is also helpful for enhancing senior managers’ hiring criteria and understanding the risks associated with powerful CEOs during crises. Further, boards of directors and top management are encouraged to delegate more power to CEOs to avoid value damage by conservative CEOs and hence stimulate positive firm outcomes, given that CEO power is expected to work effectively and help achieve a reasonable return on investment. At the same time, the board of directors should pay attention to risk-taking by powerful CEOs attempting to ensure related value-enhancing strategies because higher risk can eventually lead to excessive risk, which is detrimental to firms if not subject to cautious surveillance.

The remainder of the paper is structured as follows. Section 2 explains the underlying theoretical background of the relationship between CEO power and risk. Subsequently, Section 3 thoroughly reviews the literature on CEO characteristics, particularly CEO power and firm risk. Section 4 explains the sample and analytical methodology employed in the study. Finally, the results are discussed, and the conclusions are stated in Section 5.

2. THEORETICAL FRAMEWORK

a. Upper Echelons Theory

One of the most significant aspects of top management activities is the decision-making process (Finkelstein et al., 1996). Decision-making process is essential for planning and achieving organisational strategic goals at different levels of the organisation and should be informative as it is made by the highest management of an organisation (Finkelstein et al., 1996; Lee & Moon, 2016). Thus, different positions or levels of management and leadership make various decisions to meet organisational goals and avoid uncertainty and risks that may slow down an organisation's progress. In this sense, many organisational structures draw on a hierarchy of authority that begins with top managers such as the board of directors and the chief executive officer (CEO). In such a hierarchical structure, executive officers set strategic goals and make major decisions to enhance the organisation's performance. Obviously, operative managers, who report to the executive levels, set their departmental goals to meet executive officers' goals and facilitate information flow from upper management or executive officers.

Corporate finance studies focusing on top executives' characteristics and the board of directors are grounded in the upper echelons theory conceptualised by Hambrick and Mason (1984). The core of the theory comprises two interconnected theorems: (1) in the face of any corporate strategic situations/choices, senior executives tend to make decisions based on their personalised interpretations and judgements; and (2) relevantly, those personalised views and interpretations are impacted by the executives' personalities, values, and experiences. Consequently, their decisions are rationally bounded (Hambrick, 2007; Cyert & March, 1963). The key message delivered by the upper echelons theory is that it is possible to understand the behaviours and outcomes of an organisation by considering the characteristics, dispositions and biases of the most powerful actors in the firm, such as the top management team or chief executive officer CEO (Child, 1972; Hambrick, 2007; Cannella et al., 2009; Tang et al., 2015).

In the current study, the primary focus is placed on the CEO of corporations. They are the most influential leader responsible for the firms' sound operations, efficient strategic planning, and harmonising relationships with external stakeholders (Wei et al., 2018). As Waldman, Javidan, and Varella (2004) stated, a consensus has been reached among most management researchers on the substantial impacts of CEOs on the strategic decision-making process and the overall financial outcomes of the firms they lead (p. 356). Nevertheless, the mechanisms of such impacts remain unclear, leading to an extensive ongoing effort by academic researchers to focus on the convergence of the corporate finance and leadership fields. Building on the early development of the theory by Hambrick and Mason (1984), the emphasis is mainly on CEOs' demographic characteristics and background, such as age, gender, educational level, culture, etc. Nonetheless, the theory founders pointed out the limitations of those constructs (1984, pp. 196) such that they "may contain more noise than purer psychological measures". Consequently, at the later outset, Finkelstein and Hambrick (1996) reviewed the theory. They suggested psychological measures as more effective and direct indicators of CEO cognitions, beliefs, attitudes, values, and behavioural inclinations associated with corporate strategy formation and outcomes (Waldman et al., 2004). In line with this view, Finkelstein (1992) provided a closer understanding of leadership qualities and behaviours by suggesting an extension of the upper echelons perspective to account for the managerial power of top executives. He stated that "power may emanate from a manager's personality" (Finkelstein, 1992, p. 510). Hence, this proposition supports the primary objective of this research on CEO corporate power, which potentially impacts corporate risk, a fundamental strategic outcome of firms.

Agency theory is the prominent theoretical foundation for the direction of the relationship between CEO power and firm risk, which will be discussed in the subsequent sections.

b. Agency Theory

The agency theory of Jensen and Meckling (1976) is unarguably among the most prominent theories of organisational management, finance, and accounting (Demski & Feltham, 1978; Fama, 1980; Eisenhardt, 1985). The theory has routinely explained various factors and mechanisms relevant to corporate success and prosperity (Carver, 1997; Shapiro, 1987; Sheikh, 2019; Pathan, 2009). In brief, the agency theory postulates the existence of conflicts within the relationship between firms' principals (shareholders) and agents (managers), leading to agency costs (Amihud & Lev, 1981; Eisenhardt, 1989; Sheikh, 2019). Two primary sources contribute to such conflicts: (1) diverging goals and interests and (2) information asymmetry (Bosse & Philips, 2016; Eisenhardt, 1989). Regarding the former, it is suggested that different individuals exhibit different self-interests, which can be different and conflicting. Ones tend to behave and act to fulfil their self-interests. Consequently, in the corporate setting in which the firm's principals employ and delegate agents to run the business and create value (i.e., the separation of ownership), the agents may exhibit their own goals and interests, driving their self-serving behaviours, which can be detrimental to the firms and harm the values of the principals (Jensen & Mackling, 1976). This agency problem arises in the environment where information asymmetry exists, that is, the external principals do not possess the same information as the agents, and it is costly to fully monitor and obtain the same level of information possession with the agents (Wilson, 1968; Eisenhardt, 1989).

One central assumption underlying the agency theory acting as a key source of agency conflicts is the risk-averse nature of the managers (Bosse & Philips, 2016; Eisenhardt, 1989). Extant studies have claimed this to play a dominant role in explaining the relationship between CEO power and firm risk (Lewellyn & Muller-Kahle, 2012; Liu & Jiraporn, 2010; Pathan, 2009; Sheikh, 2019). Specifically, it has been assumed that shareholders (the principals) are risk-neutral or risk-seeking, whilst the managers are risk-averse, or at least more risk-averse than what the shareholders expect them to be (Wiseman & Gomez-Mejia, 1998; Carpenter et al., 2003; Eisenhardt, 1989; Amihud & Lev, 1981). The reason is that the shareholders have well-diversified their investment portfolios (wealth) and hence receive unlimited payoffs in successful projects and only limited losses when those do not perform well. In contrast, managers exhibit poor-diversified human capital and financial well-being because their primary source of income is tied exclusively to the performance and survival of the firms they work for. As a result, once the managers reach the top executive role as a CEO, which tends to yield a relatively more generous compensation and benefits package, as well as personal reputation, image, and experience, they are likely to become protective over their position. This can lead to a risk-averse attitude toward corporate decision-making, and the corporate consequence of such a risk attitude is to drive the CEOs to accept low-risk but value-destroying and reject risky but value-enhancing projects (Grinstein & Hribar, 2004; Lewellyn & Muller-Kahle, 2012).

Building on this perspective of the agency theory, the literature on CEO power and firm risk, such as Grinstein and Hribar (2004), Lewellyn and Muller-Kahle (2012), Sheikh (2019), and Liu and Jiraporn (2010), conjectures that power of CEOs provide them the ability and freedom (relative to their boards and other management team members) to influence the firm's strategic decisions, including the corporate risk level; and most importantly, the monitoring on their behaviours will be lessened with power (Fernandes et al., 2021; Pathan, 2009). In other words, powerful CEOs possess more leeway and the ability to pursue actions in their best self-interest while hurting the interests of the shareholders. Applying this to the assumption of risk avoidance characteristic of managers due to employment and reputational risk, powerful CEOs tend to adopt more risk-averse risk decisions, leading to lower firm risk (Pathan, 2009).

While the agency theory supports the negative relationship between CEO power and firm risk based on the risk-averse agent assumption, the theory exposes some competing views. In particular, the agency theory fails to consider the contexts in which managers can exhibit managerial risk-seeking behaviours (Lewellyn & Muller-Kahle, 2012; Sheikh, 2019). Consequently, the following section will discuss the behavioural agency model (BAM) of risk-taking (Wiseman & Gomez-Mejia, 1998) in combination with the approach/inhibition theory of power (Keltner et al., 2003), which can provide an alternative theoretical foundation for the relationship between CEO power and firm risk.

c. *The behavioural agency model of risk-taking (Wiseman and Gomez-Mejia, 1998) and the approach/inhibition theory of power (Keltner et al., 2003)*

The BAM integrates the agency and prospect theories of Tversky and Kahneman (1986) to enhance the explanatory values of the agency-based models of executive risk-taking behaviour (Wiseman & Gomez-Mejia, 1998). The prospect theory conceptualises that individuals do not exhibit a constant risk preference, but instead, one can be risk-averse or risk-seeking based on a reference point. Particularly, people tend to be risk-seeking in the loss domain and risk-averse in the gain domain (i.e., different problem framing). The gain domain refers to "available options of varying risk and returns generally promise acceptable, expected values", and the loss domain occurs "when available options generally promise unacceptable expected values" (Wiseman & Gomez-Mejia, 1998, p. 135). This is to say, CEOs as individuals can be risk-seeking and risk-averse (Sawers et al., 2011).

Bringing the BAM's view in the context of CEO power, the inhibition/approach theory of power conceptualises that power is a critical source of human interaction that "transforms basic psychological processes" of individuals, and in particular, their behavioural approach system (Magee & Galinsky, 2008, p. 366; Keltner et al., 2003). Unlike the behavioural inhibition system, this approach system triggers individuals to focus more on positive outcomes (e.g., rewards and achievements) (Keltner et al., 2003; Karniol & Ross, 1996). Social psychologists, for example, Anderson and Galinsky (2006), provided experimental evidence supporting that the propensity for risk-taking behaviour increases with power because powerful individuals tend to be more optimistic in their risk perception. Furthermore, CEOs with a sense of power are often overconfident about their ability and skill. This causes a greater concern for judgment error in risky decisions (Adams et al., 2005; Sah & Stiglitz, 1991).

Consequently, it can be posited that powerful CEOs with greater possession of resources with less invigilation and fewer constraints would focus their motivations, actions, and emotions more on potential corporate achievements and rewards (the trigger of the CEO approach system). Consequently, they are more likely to commit to risk-seeking behaviours because the cognitive bias has been activated, causing the potential loss/threat to be overlooked (Lewellyn & Muller-Kahle, 2012; Keltner et al., 2003; Anderson & Berhahl, 2002). Consequently, corporate risk is heightened. By relaxing the restrictive risk-aversion assumption of the agency-based theory, the behavioural agency model and the inhibition/approach theory propose an additional positive relationship between CEO power and firm risk.

3. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

a. CEO characteristics and firm risk

Over the past two decades, an extensive body of corporate governance research has emphasised the importance of CEO characteristics on firm risk. Specifically, the research stream consistently reports that the CEO characteristics, such as age, gender, marital status, facial features, managerial incentives, overconfidence, political viewpoint, religious belief, and social network, are relevant indicators of firm risk (see e.g. Çolak & Korkeamäki, 2021; Brisley et al., 2021; Fan et al., 2021; Neyland, 2020; Kamiya et al., 2019; Faccio et al., 2016; Serfling, 2014; and so on[1]). For example, Fan et al. (2021) and Ferris et al. (2017) pointed out that firm

[1] Hirshleifer, Low and Teoh (2012); Coles, Daniel, and Naveen (2006); Hilary and Hui (2009); Hutton, Jiang, and Kumar (2014); Serfling (2014); Cain and McKeon (2016); Ferris, Javakhadze and Rajkovic (2017)

risk, which seemed to be increased when the board-CEO had a wide social network, included investments, operating, and financing strategies. Such an increase in firm risk may lead to instability in the firm's stock returns. Serfling (2014) investigated the influence of CEO’s age on corporate risk-taking and the performance of firms listed in ExecuComp between 1992 and 2010. He found that younger CEOs tended to increase firms' investments in research and development; therefore, firm risks would be increased accordingly. In contrast, older CEOs tended to be more conservative in diversifying firms’ investments and acquisitions and invested less in research and development. Therefore, firm risks would be reduced, and its return on investments would be maintained.

Faccio et al. (2016) documented that firms led by female CEOs tend to adopt lower-risk decisions (e.g., leverage) and, hence, are exposed to lower firm risk in terms of less volatile earnings. Interestingly, a study conducted by Neyland (2020) postulated that divorce seemed to exacerbate firm risk. The results indicated a negative relationship between divorce and equity risk. In other words, the higher CEO divorce rate was associated with significantly lower equity risk due to reduced diversification and risk-taking incentives because CEOs’ wealth was decreased during divorce procedures. However, those reductions in volatility were followed by increases in firm risk due to increases in CEOs' risk incentives and compensation after their divorce.

Furthermore, Kamiya et al. (2019) investigated the effect of CEO face-masculine on firm risk. The authors used non-financial firms to collect their studied data from the Execucomp database for 1162 CEOs' facial pictures for the period from 1993 through 2009. The study indicated that volatilities in returns and financial leverage could be linked to a CEO’s physical appearance due to the CEO’s readiness to take risks. For instance, those with masculine faces tend to invest more in acquisitions, indicating a significantly positive relationship between the CEO's face and the firm's risk. This study appeared to measure firm risk and judge CEOs’ personalities based on physical appearance.

Another study by Çolak and Korkeamäki (2021) focuses on the CEO mobility of firm risk. The authors measured CEO mobility and used a policy risk-related index to determine the aggregated risk within a firm's corporate policies. The authors created the riskiness index due to a lack of a unified riskiness index. The results revealed a positively significant relationship between CEO mobility and risk-related issues in corporate policies. The authors concluded that external regulatory shocks impeding labour mobility were most likely to reduce corporate risk-taking and the firms' overall risk level.

Overall, this section provided empirical support for the upper echelon theory, which posits the relationships between CEO characteristics, backgrounds, and psychological mechanisms on firm risk raking and firm risk. In the same vein, the current study focuses on CEO power as a potential indicator of firm risk.

b. CEO power and corporate strategic decisions and outcomes

As important as other CEO characteristics, CEO power has been claimed to be a critical determinant of corporate strategic decisions and outcomes. For example, Onali, Galiakhmetova, Molyneux, and Torluccio (2016) investigated the role of powerful CEOs and governments in overseeing bank policy—the collected sample comprised 109 European banks covering years from 2005 through 2013. The authors employed three key proxies to assess CEO power. The three proxies are CEO ownership, tenure, and unforced CEO turnover. The authors contended that evidence showed that CEO power negatively impacted dividend pay-out ratios and banks' performance. This relation resulted from CEOs' fewer incentives to maximise pay-out ratios to minimise overseeing from minority shareholders. The study highlighted that internal board of directors' governance, which formed a greater ownership stake of the board members, could increase performance but decrease pay-out ratios.

Muttakin, Khan, and Mihret (2018) built on a resource-based view to explore the moderating effect of CEO power on the relationship between directors' human and social capital and corporate social responsibility (CSR) disclosures. According to the authors, the resource-based view is accepted as a tool to measure the effectiveness of experience and networks as well as the knowledge of the director. Using a sample of firms listed on the Dhaka Stock Exchange in Bangladesh from 2005 to 2013, the study showed that board capital was positively linked to CSR disclosure. On the contrary, CEO power showed a negative relationship regarding CSR disclosures. Such a negative relationship was most likely to reduce the effectiveness of board capital in CSR disclosures. Furthermore, it is also found that although board capital could enhance CSR practices, CEO power could impede these practices. Self-interest probably motivates powerful CEOs and makes them disinterested in investing in CSR initiatives. Second, powerful CEOs appear to hire directors for the board based on family or personal relationships; therefore, directors are more likely to support the CEO's preferences.

Similarly, Jiraporn and Chintrakarn (2013) investigated the view of powerful CEOs on corporate social responsibility (CSR) investments using a sample of 1370 firms from 1995 to 2007. The authors adopted the CEO pay slice as the main proxy of CEO power following Bebchuk et al. (2011). The results of this study showed that CEOs who had less power tended to increase CSR engagement. However, CEOs with more power were entrenched and invested less in CSR. The authors concluded that the relationship between CEO power and CSR investments was non-monotonic. This study explains the findings based on the agency view regarding payments and other benefits CEOs receive when investing in CSR projects (Jiraporn & Chintrakarn, 2013).

Another study by Chikh and Filbien (2011) examined CEO power on acquisition decisions concerning market reactions to acquisition announcements. The study proposed that the CEOs of acquiring firms were likely to discontinue any deals if the market went opposite their plans. However, as the authors put it, well-connected and powerful CEOs were exceptions because they seemed less likely to discontinue any deals regardless of the market condition. The authors tested a sample of 200 French acquisition announcements from 2000 to 2005 from the Securities Data Company's (SDC) database. The authors employed a probabilistic model, structural ownership, expertise, and prestige power proxies. The results of this study showed that CEOs who were the chair of the board, i.e., CEO structural power, tended to demonstrate self-confidence due to their position, social network, and acquisition experience. Overall, the study concluded that CEO power and social networks appeared to increase the possibility that a deal would be closed regardless of market investors' approval. However, CEOs who went in the opposite direction of the market tended to achieve higher long-run returns for their firms.

CEO power has also been found to be associated with firm board composition. Baldenius, Melumad, and Meng (2014) particularly shed light on CEO power regarding board selection. The authors assumed that powerful CEOs tended to recruit a board that was excessively focused on monitoring. On the other hand, shareholders were likely to appoint an adviser-heavy board. The authors employed an empirical model that drew on the following hypothesis under centralisation, the board makes the decision and delegation, the CEO makes the decision. The results showed that CEOs appointed to the board appeared more willing to delegate decision-making power to the CEO, which may increase CEOs’ entrenchment risk.

More recently, DeBoskey, Luo, and Zhou (2019) investigated the relationship between powerful CEOs and the tone of their earnings announcements. The author analysed a series of non-financial U.S. corporations from 2008 to 2013. Using two proxies of CEO power, expert power (CEO tenure) and structural power (CEO-chairman duality), the study revealed that CEO tenure and CEO duality were significantly positively associated with earnings announcement tone. Board oversight mechanisms seemed to reduce the effect of CEO tenure, specifically when board members have higher reputation costs. In contrast, board oversight mechanisms may have less impact on CEO duality. The authors concluded that CEO power and board oversight barely impacted earnings announcement tone. This study appeared to focus on the internal management style and play on psychological aspects, which are not within the interest of this study.

Han, Nanda, and Silveri (2016) raised the question of powerful CEOs' response to pressure from the economic environment. The authors proposed that CEOs' decision-making process appeared quick in times of pressure and led to severe consequences for the firm because CEOs were less likely to receive independent advice or to study their decisions. Applying the concept of CEO power, the authors measured the performance of firms with powerful CEOs during industry downturns. CEO power is constructed using an index comprising seven variables: CEO Pay Slice, Duality, Triality, Tenure, Ownership, Non-Independent Directors, and Founder. The findings concluded that powerful CEOs are less likely to consult advice from independent experts before deciding under pressure. Across different firm settings, including innovative firms, firms with relatively little related-industry board expertise, firms operating in competitive industries, and firms operating in industries characterised by relatively greater managerial discretion, the study reported that firms led by powerful CEOs tend to perform worse. The key concern is the centralised decision-making habit of CEOs with power.

Similarly, another study (Gupta et al., 2018) drew on the ongoing exchange between agency theory and the strategic leadership perspective. As stated by the authors, the agency proposes that CEO power is detrimental to the firm. In contrast, the strategic leadership view assumes that the role of CEO power is indeed complementary. Therefore, CEO power "seems to be a double-edged sword". Given such context, the study assessed the CEO's power and firm performance during difficulties and industry instability. This study employed situational exigencies—managerial discretion, market competitiveness, and technological innovativeness to examine CEO power. The authors hypothesised that CEOs' power impacted firms negatively during industry turmoil. The authors tested 1500 publicly traded Standard & Poor's (S&P)

firms in the United States from 1992 to 2009. The results of this study indicated that CEO power did not enhance firms' performance during industry downturns. Specifically, firms with powerful CEOs performed worse in industries with innovativeness, greater competition, and high discretion. The results of this study appeared to confirm agency theory and disconfirm the strategic leadership view. Perhaps it seems necessary to examine the effect of CEO power on growth. The results of this study need data from other countries to be validated due to the scope of the study (US-based firms).

Powerful CEOs could pressure their firms and boards to invest in research development and acquisition and divest social responsibility. For instance, Chen (2014) shed light on the effect of board capital and the moderating effect of CEO power on R&D investment. The author drew on resource dependence theory to analyse their data. One of the premises of this theory is that an organisation depends on outsourcing to run effectively (Ebers & Semrau, 2015). Chen (2014) put forward that a powerful CEO could motivate directors to offer more resources to increase the R&D investment necessary and enhance innovation capabilities. The findings of this study showed that CEO power played a significant role in positively increasing R&D investments and affecting the board capital. The authors concluded that competing firms in the innovation and electronic industry maintain a combination of powerful CEOs and a board of directors featuring educated directors, industry-specific experience, and interlocking directorate ties. Therefore, firms should consider education, relevant experience, and social connections when recruiting CEOs and directors.

c. CEO power and firm risk

Provided extensive literature on CEO power and corporate strategic decisions and outcomes; as mentioned, there is a growing research line with the focus being put on the relationship between CEO power and firm risk-taking, and hence, firm risk as a consequence. Nevertheless, the findings remain inconclusive. These studies will be discussed in this section based on the academic contributions of this study, which can be highlighted, and hypotheses will be developed.

On the negative side, Fernandes et al. (2021) and Pathan (2009) conducted their studies on bank samples, i.e., publicly listed European and large US banks, respectively. They both employ CEO duality as the main measure of CEO power, while Pathan (2009) additionally use internally hired CEOs. Both studies employ the total risk, measured by the stock return volatility, and Pathan (2009) also considers the systematic and idiosyncratic risks of firms. Their findings indicate that banks led by powerful CEOs tend to exhibit lower risk. This holds for crisis and non-crisis periods. As discussed in the theoretical framework section, the agency-based view supports a negative relationship between CEO power and corporate risk, which posits that CEOs' wealth is mostly concentrated and tends to rely on the firms they lead. Furthermore, if CEOs receive fixed wages, they do not have so much financial gain if the banks do well, but in bankruptcy, they can lose their job and reputations. Consequently, it is expected that they are likely to protect their wealth by making corporate safe choices, which can be harmful and value-damaging for firms (Smith & Stulz, 1985). Therefore, if CEOs possess greater power to exercise their voices in the corporation's decision-making process and can influence the monitoring of the board and other senior management leaders, they can and are likely to act in a conservative and protective investment manner, i.e., actions that are compatible with their self-interest, leading to lower risk (Johnson et al., 1993).

While CEO power was empirically found to be negatively associated with corporate risk in banks, such a relationship is positive for non-banking firms (Sheikh, 2019; Lewellyn & Muller-Kahle, 2012). A rationale for this is that banks are highly leveraged corporations and, thus, are highly exposed to bankruptcy risk. Therefore, the employment and reputational risk for CEOs in banks is more inherent than that of other non-banking firms. This drives CEOs to be more inclined to risk-averse behaviours (Pathan, 2009; Parrino et al., 2005), leading to lower corporate risk. To provide more details on the non-banking studies, Sheikh (2019) scrutinised the relationship between powerful CEOs and their corporate risk regarding market competition and corporate governance. The author examined US non-banking firms from 1992 through 2015. The author suggested that significant market competition and effective corporate governance seemed to increase risk-taking tendencies among CEOs with power. Based on the total and idiosyncratic risk analysis, this study showed that CEOs with power preferred to take more risks. However, CEOs with more power tended to develop a significant risk-taking disposition, mainly when the market competition was high and corporate governance was strong. Additionally, Lewellyn and Muller-Kahle (2012) also revealed that the power of CEOs and firm risk showed a significantly positive link in the subprime lending industry. Their consistently optimistic CEO power-risk relationships are supported by the behavioural agency theory of Wiseman and Gomez-Mejia (1998), which relaxes the restrictive risk-aversion assumption of the agency theory. With the view that CEOs exhibit risk preference ranking from risk-averse to risk-seeking, in combination with the approach/inhibition theory of power (Keltner et al., 2003), it is stipulated that more powerful CEOs are often more optimistic about their decisions' intrinsic payoffs, and at the same time, disregard the associated potential downside/risk (Anderson & Galinsky, 2006). As a result, firm value and risk variability are higher for firms led by powerful CEOs (Hirshleifer et al., 2012). In the paper of Lewellyn and Muller-Kahle (2012, pp.291), the authors also explain their finding such that powerful CEOs tend to "failed to consider the well-established view that subprime mortgages are likely to end up in default", leading them to commit heavily on such high-risk lending.

Despite the inconclusive pictures of the influences of CEO power on corporate risk, both theoretically and empirically. Since the current study employs a non-banking sample, the prediction of the study findings is based on the previous non-banking studies. Consequently, the following hypothesis will be tested:

H1: CEO power is significantly positively correlated with firm risk.

Extending the CEO power—risk research stream, this study examines the relationship using an international sample comprising firms operating in the G7 countries from 2006 to 2021.

d. Financial crisis 2007 and COVID-19 pandemic crisis 2020

To learn more about the relationship between CEO power and firm risk, this study assesses whether such a relationship remains unchanged during times of crisis. The CEO power has been documented thus far to increase firm risk since with the possession of power, CEOs tend to be more optimistic and overlook risk (Section 3. c). Nevertheless, corporations are exposed to much greater uncertainty during the corporate financial distress caused by market-borne crises. Such market conditions can raise the awareness of powerful CEOs, reducing their optimism and risk-taking propensity. Consequently, we expect that the positive power-risk relationship reduces during crises.

We separate the examination of the crisis moderating effect on the financial crisis of 2007 and the health of COVID-19 in 2020. The two crises had disastrous and contagious consequences on the global economic and financial markets. The influences of global financial and COVID-19 health crises went beyond the economy to affect the household debt bubble, tourism, healthcare issues, finance and education. The economic recess that was associated with the two crises is relatively comparable. For instance, the global financial crises of 2007 and the COVID-19 pandemic emerged in an industrial economy (the United States in 2008 and China at the end of 2019), and their impact spread worldwide. Such a global impact is difficult to predict and avoid because of its hidden embedded uncertainty (Frank Knight, 1921; Marc-Olivier Strauss-Kahnay, 2020).

Despite the two crises' similarities in terms of their overall global disastrous phenomenon, the nature and impacts of the two crises are somewhat distinct and, hence, may have different implications on the operations and financial positions of corporations around the globe. For example, the origin of the financial crisis was embedded within the economy, i.e., the hidden household-debt bubble, whilst the COVID-19 crisis is a health crisis, a global pandemic outbreak which is outside the economic system (KOF, 2021), and their impacts (the extent and length) are also different, from the perspective of global trade and industrial output.

Notably, other regional crises, such as the Eurozone crisis 2008, are not considered. In our research, we focus on the G7 countries, which are classified based on their economic features rather than geographical location. This classification emphasises shared economic characteristics, such as advanced economies, high GDP, and significant influence on global markets (GAC, 2024). Given this framework, regional crises are less relevant to our analysis.

Particularly, the Eurozone crisis, while severe, predominantly impacted specific EU countries that used the euro and experienced high levels of sovereign debt (GAC, 2024). Although it had repercussions for global financial markets and highlighted vulnerabilities in European integration, its effects were largely confined to the Eurozone and did not uniformly affect all G7 nations. Countries like Canada, Japan, and the United States had varying degrees of exposure to the crisis, which limited the relevance of incorporating such a regionally focused event into our research on the G7.

In contrast, the global financial crisis 2007 and the COVID-19 pandemic 2020 had far-reaching, indisputable impacts on economies worldwide, including all G7 countries. These events triggered widespread economic disruptions, affecting supply chains, financial markets, and labour forces globally. As a result, their influence transcended regional boundaries and affected the economic landscapes of G7 nations in similar ways.

As seen in Figure 8, the downward damage caused by the two crises is relatively similar. However, the recovery of the economy post-COVID is speedier and stronger than that post-COVID crisis. This is because the health crisis was rooted in the pandemic; global and national actions targeting the outbreak would directly improve the situation. Overall, due to the different natures of the two crises, it is essential to identify whether they impose different influences on the way and extent to which a powerful CEO would be associated with firm risk.

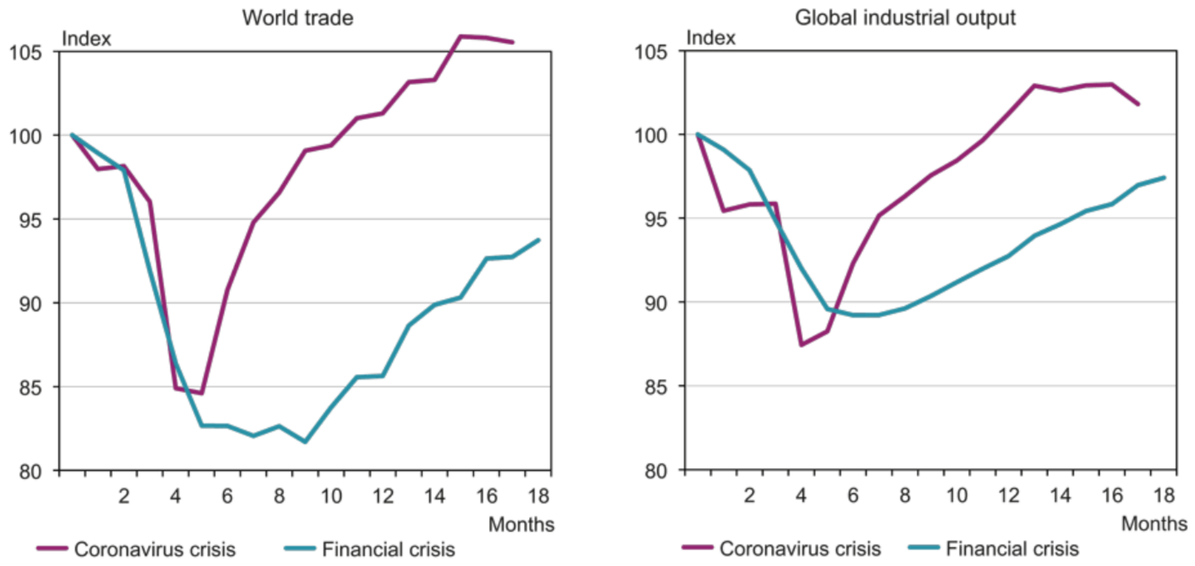


Figure 8: World trade and global industrial output – the impacts of the financial crisis and health crisis (KOF, 2021)

Overall, it is to point out that this study focuses on the context of the financial crisis of 2007 and the ongoing COVID-19 pandemic to determine whether the influences of the CEO's power on firm risk are mitigated under uncertain and distressed market conditions. Thus, the following hypotheses will be tested:

H2: Crises, such as global financial and COVID crises, negatively affect the relationship between CEO power and firm risk.

4. METHODOLOGY

a. Sample formation

The study employs a cross-country panel data sample containing publicly listed firms in G7 countries: the United States, the United Kingdom, Germany, France, Italy, Canada, and Japan.

The investigation covers a period from 2006 to 2021. The global financial crisis 2007 and the ongoing COVID-19 crisis are considered through this period. The financial, governance composition and macroeconomic data are obtained from several databases. The firms' financial accounting data and daily stock prices are collected from the Refinitiv Datastream database. The governance-related data, including board composition and CEO characteristics, is obtained from WRDS BoardEx. Lastly, macroeconomic data is from different sources such as World Bank and International Monetary Fund (IMF) databases.

The initial sample contains all G7 firms whose data are available on the WRDS Boardex database, the leading database on governance data, specifically board and CEO compositions. Therefore, the firm list is better covered than if being restricted by market indexes. After dealing with missing values, the final sample employed in this study contains 12,836 firm-year observations. All accounting variables are winsorised at the 1st and 99th percentiles to tackle the potential issues of outliers. The descriptive statistics of the final sample will be provided and discussed in Section 5.a.

b. Dependent variable: Firm risk

To measure firm risk, the study employs three proxies: total risk (TR), systematic risk (Risk_Sys), and idiosyncratic risk (Risk_Idio). These three measures of corporate risk have been widely used in the literature (see, e.g. Bernile, Bhagwat, and Yonker, 2018; Anderson & Fraser, 2000; Chen et al. (2006); and Pathan (2009), Laeven and Levine (2009), to mention a few). Following Anderson and Fraser (2000), the risk measures are computed as follows:

- Total risk (TR) = The yearly standard deviation of each firm's daily stock returns. A firm's daily stock return can be measured as $R_{it} = \ln\left(\frac{P_{it}}{P_{i,t-1}}\right)$, where R_{it} is the daily stock return of firm i for day t; P_{it} and $P_{i,t-1}$ are the firm i's closing stock price for day t and day t-1, respectively. The firm's total risk captures the volatility of a firm's stock returns each year, providing market participants with perceptions of the risks exposed by the firm.
- Idiosyncratic risk (Risk_Idio) = The standard deviation of the residuals obtained from the single-index market model presented in Equation 1:

$$R_{it} = \alpha + \beta * R_{M,t} + \epsilon_{i,t} \qquad \text{(eq. 1)}$$

where R_{it} is the daily stock return of firm i for day t, $R_{M,t}$ is the daily return of the market index for day t. The market index is the main index of each country. $\epsilon_{i,t}$ is the error term. Idiosyncratic risk is the firm-specific risk capturing the influences of firm-specific factors and conditions on the firm's stock volatility.

- Systematic risk (Risk_Sys) = Total risk – Idiosyncratic risk. This risk is the market risk, capturing the impacts of the whole market conditions on firms.

c. ***Main independent variable: CEO power***

The CEO power is not a characteristic that can be directly observable (Liu & Jirapor, 2010). Therefore, the literature has debated more objective proxies/measures/indicators capturing CEO dominance (Pfeffer, 1981; Salancik & Pfeffer, 1974; Provan, 1980). The extant literature has employed several proxies. These include CEO duality, where a firm appoints the same person for both chairman and CEO roles (Chikh & Filbien, 2011; Haynes & Hillman, 2010; Pathan, 2009; Zhu & Chen, 2015); CEO tenure captures the length (in years) that CEOs have been holding their positions, whose logarithm values are taken (Onali et al., 2016; Sariol & Abebe, 2017); board independence measures the proportion of independent (outside) board members (Lewellyn & Muller-Kahle, 2012; Daily & Johnson, 1997), and so on.

In the current study, the main proxy of CEO power employed is the CEO Pay Slice (CPS)[2], which measures the CEO's relative compensation among top executives. It captures the CEOs' relative significance in the management team in terms of their contribution, power, and ability; the CPS as a proxy of CEO power has been increasingly used in recent years by, for example, Ferris, Javakhadze, and Rajkovic (2017); Bebchuk et al. (2011); Chen et al. (2013) and more.[3] Its growing popularity stems from its ability to indicate significant CEO bargaining power**.** CEOs with greater organisational power often leverage their position to negotiate more favourable compensation packages than their peers. This disparity in pay can reflect the CEO's dominance over critical decisions and influence over the board and other key executives. The CEO's ability to secure a higher compensation package relative to others within the firm is a tangible reflection of their elevated authority and sway in corporate governance.

In addition to signalling power, CPS may reflect the CEO's perceived value to the company**.** A higher CPS can be seen as a reward for the CEO's experience, achievements, or unique expertise, which sets them apart from other executives. Companies frequently compensate their

[2] "Total compensation includes salary, bonus, other annual pay, the total value of restricted stock and options granted that year, long-term incentive payouts, and all other total compensation (Bugeja, Matolcsy, and Spiropoulos, 2017)".

[3] Zurbruegg and Jaroenjitrkam (2020); Usman, Zhang, Farooq, Makki, and Dong (2018); Munir, Kok, Teplova, and Li (2017); Liu and Jiraporn (2010); Vo and Canil (2019).

top executives based on their critical roles in driving performance. In this sense, a larger share of the pay pool indicates power and a recognition of the CEO's strategic importance, with the compensation package functioning as a retention tool to keep a highly valued leader at the helm.

Moreover, CPS is particularly valued for its objectivity and firm-specific relevance**.** CPS inherently accounts for firm-specific characteristics like industry, size, and market conditions by comparing the CEO's compensation to that of other top executives within the same organisation. This ensures that the measure reflects internal dynamics rather than being influenced by external factors. Bebchuk et al. (2009) argue that CPS provides a more accurate and objective measure of CEO power since it focuses on relative compensation within a company, thereby offering a clearer picture of the CEO's role in shaping corporate decisions.

Furthermore, CPS effectively captures the CEO's centrality within the management team**.** As noted by Liu and Jiraporn (2010) and Finkelstein (1992), the measure reflects the CEO's dominance in decision-making and leadership within the firm. A high CPS underscores the CEO's central role in strategic initiatives and overall corporate direction, further solidifying their authority over the company's management team.

Therefore, this measure has been claimed to be a more objective, useful, and advantageous measure in comparison to others due to its ability to capture "the relative centrality of the CEO in the top management team" (Liu & Jiraporn, 2010, p. 748; Finkelstein, 1992) as well as its strong explanatory power for a firm's corporate outcomes (Bebchuk et al., 2006 and Bebchuk, Cohen, and Ferrell, 2009). Furthermore, CPS is constructed using compensations of executive directors of the same companies. This is to say, any firm-specific characteristics are controlled for (Bebchuk et al., 2009).

Following the same approach employed in the literature, the CEO pay slice (CPS) is computed as the percentage of the CEO's total compensation to the total compensation of the top five executives in each firm. The mathematical computation of CPS can be written as follows:

$$CPS = \frac{CEO\ total\ compensation}{\sum Top{-}five\ executives'\ compensations\ (including\ CEO)} \qquad \text{(eq. 2)}$$

d. Controlling variables

Following the literature (e.g. Yung and Chen, 2018; Wang, 2011; Coles et al., 2006; John et al., 2008), three groups of controlling variables are employed. These include firm-level characteristics, CEO characteristics, corporate governance compositions, and country-level controls. For the firm-specific controls, the study uses firm size (logarithm of firm total asset), firm age (years), sales growth (annual sale growth, %), profitability (EBITDA/total asset), research and development expense (% R&D to total asset), growth opportunity (market to book ratio), asset tangibility (% net fixed asset to total asset), market leverage, dividend cut (dummy variable) and cash surplus (% surplus cash to total asset). Additionally, corporate governance and CEO characteristics controlling variables comprise board size (number of board directors), female board representation (% female directors on board), CEO age, CEO gender, CEO wealth delta, CEO tenure, and CEO education. Lastly, macroeconomic variables are controlled, including annual GDP growth rate, annual inflation rate, foreign direct investment, trade per capita GDP, financial crisis and COVID-19 crisis dummies. Table 1 provides a detailed computation and explanation of these controlling variables.

TABLE 1: DEFINITIONS AND MEASURES OF CONTROLLING VARIABLES

VARIABLES (ABBREVIATION)	*DEFINITIONS & MEASURES*	*CITATIONS*
Firm size (SIZE)	Firm total asset = ln (TA)	Yung and Chen (2018); Wang (2011); Bernile et al. (2018); Sanders and Hambrick (2007); Coles et al. (2006); Faccio et al. (2016)
Sales Growth (Growth)	The annual growth rate in sales = ln $(\frac{Sale_T}{Sale_{T-1}})$	Yung and Chen (2018); Fan et al. (2021); Faccio et al. (2016); Kamiya et al. (2019)
Profitability (Profit)	Corporate earnings = $\frac{Earnings\ before\ interest, tax, depreciation, amortisation}{Total\ asset}$	Yung and Chen (2018); Bernile et al. (2018); Fernández-Méndez and Pathan (2022)
R&D expense (R&D%)	% research and development expense to total asset = $\frac{R\&D\ expense}{Total\ asset}$	Yung and Chen (2018); Bernile et al. (2018); Coles et al. (2006); Sila et al. (2016)
Growth opportunity	Market to book value ratio	Yung and Chen (2018); Wang (2011); Coles et al. (2006); Bernile et al. (2018)
Asset tangibility (CAPEX)	% net fixed asset to total asset = $\frac{Net\ PPE}{Total\ asset}$	Yung and Chen (2018); Bernile et al. (2018); Coles et al. (2006); Faccio et al. (2016)
Market leverage (Leverage)	% of debt financing to firm market value = $\frac{Short-term\ debt + Long-term\ debt}{Total\ assets - Book\ equity + market\ equity}$	Yung and Chen (2018); Bernile et al. (2018); Coles et al. (2006)

Surplus cash (Cash_surp)	% surplus cash to total asset = $\frac{Operating\ net\ cash\ flow - Depreciation\ and\ Amortisation + R\&D\ expense}{Total\ Assets}$	Yung and Chen (2018); Wang (2011); Almeida et al. (2004); Bernile et al. (2018); Fan et al. (2021); Sila et al. (2016)
Dividend cut (Div_cut)	The dummy variable takes the value of unity if the annual dividend payout is reduced and zero otherwise.	Yung and Chen (2018), Benito and Young (2003), Ali (2021)
Board size (Board_size)	Number of directors on the firm board of directors.	Yung and Chen (2018); Wang (2011); Fan et al. (2021); Sila et al. (2016); Deutsch et al. (2011)
Female representation (%female)	The fraction of female directors on the board	Sila et al. (2016); Chen et al. (2019); Faccio et al. (2016)
CEO age (CEO_Age)	The biological age of the CEO (in years)	Coles et al. (2006); Fan et al. (2021); Serfling, (2014); Benischke et al. (2019); Faccio et al. (2016)
CEO tenure (CEO_Tenure)	Number of years that the CEO has been holding their positions.	Cain and McKeon (2016); Coles et al. (2006); Hirshleifer et al. (2012); Ferris et al. (2017); Hagendorff and Vallascas (2011); Onali et al. (2016); Chikh and Filbien (2011).
CEO gender (CEO_fem)	The dummy variable takes the value of unity if the CEO is female and zero otherwise.	Fan et al. (2021); Benischke, Martin, and Glaser, (2019)

CEO wealth delta (Delta)	The change in dollar value of CEOs' wealth for one percentage point change in stock price	Yung and Chen (2018); Coles et al. (2006); Sila et al. (2016); Kini and Williams (2012)
CEO Education (CEO_Edu)	The dummy variable takes the value of unity if the CEO has a master or above and zero otherwise.	Fan, Boateng, Ly, and Jiang (2021); Bowen et al. (2010); Kim and Lu (2011); Cain and McKeon (2016); Ferris et al. (2017); Li et al. (2019); Haynes et al. (2019)
Financial crisis (Crisis_F)	The dummy variable takes the value of one if the firm-year observations fall in the global financial crisis period 2007-2009 and zero otherwise.	Bastos and Pindado (2013); Hlaing and Kakinaka (2018)
Covid crisis (Crisis_C)	The dummy variable takes the value of one if the firm-year observations fall in the COVID-19 crisis period 2020-2021 and zero otherwise.	Shehzad et al. (2020); Chen and Yeh (2021)

e. Data analysis: Estimation models

As discussed in Section 4, the study employs the Ordinary Least Square (OLS) with clustered standard error at the firm level as the baseline method to test for the developed hypotheses. The following regression models will be performed:

$$TR_{i,t}/Risk\_Idio_{i,t}/Risk\_Sys_{i,t} = \alpha_{i,t} + \beta_1 * CPS_{i,t} + \sum_{n=2}^{n=22} \beta_n * X_{n,i,t} + Year.FE + Industry.FE + Country.FE + \epsilon_{i,t},$$

(eq. 3)

The dependent variables are the three primary risk measures capturing the total risk, idiosyncratic risk, and systematic risk of firm i for year t ($TR_{i,t}$, $Risk\_Idio_{i,t}$, $Risk\_Sys_{i,t}$, respectively). $CPS_{i,t}$ is the main independent variable. It is the CEO power proxied by the CEO pay slice (CPS), and hence, β_1 captures the potential relationship between CEO power and firm risk. $X_{n,i,t}$ are all controlling variables being accounted for, as explained in the previous section, and β_n are their corresponding relationship*s* with firm risk. The regression estimation also takes into account the year-fixed effect, industry-fixed effect and country-fixed effect. These dummy variables tackle the time-invariant omitted/unobservable issues related to each industry and country. Furthermore, the clustered standard error option is utilised to deal with the issue of heteroskedasticity and autocorrelation, i.e. inconstant and correlated error terms, respectively. This cluster option has been claimed to provide true standard error even when the error terms are not independently and identically distributed (i.i.d) (Greene, 2003, p. 267; Stock and Watson, 2003, p. 504, White, 1980 and Eicker, 1967).

f. Robustness checks

To provide further assurance to the findings obtained from the baseline method, several robustness checks will be performed, which can be classified in the following ways:

i. Robustness checks with alternative dependent variables

Three additional risk measures will be employed (Pathan, 2009). These are (1) assets return risk (ARR) and, (2) bankruptcy risk (Z_score), and (3) operating risk (SD_ROA). Following Flannery and Rangan (2008) and Pathan (2009), the ARR measure is computed as the standard deviation of the firm's daily stock returns MULTIPLIES the ratio of market capitalisation to market value of total asset MULTIPLIES a square root of 250. The mathematical computation can be written as follows:

$$\text{ARR} = \text{SD}(R_{it}) * \frac{Market\ capitalisation}{Total\ liabilities + Market\ Equity} * \sqrt{250} \qquad \text{(eq. 4)}$$

On the other hand, the insolvency risk is measured by Z-score as follows:

$$\text{Z\_Score} = \frac{(3.3 * EBIT) + (1 * Net\ sales) + (1.4 * Retained\ earning) + (1.2 * (Working\ Capital\ ))}{Total\ Asset} + \frac{(06 * market\ value\ of\ equity/book\ value\ of\ total\ liabilities)}{Total\ Asset} \qquad \text{(eq. 5)}$$

where EBIT is the earnings before interest and tax. The higher the Z-score, the lower the bankruptcy risk (Calandro, 2017). Lastly, the operating risk can be measured as the standard deviation of returns on assets over the previous 4-year period (t-4, t) (Yung & Chen, 2018; Wang, 2011).

$$\text{SD\_ROA} = \sigma(\text{ROA}_{t-4,t}) \qquad \text{(eq. 6)}$$

ii. Robustness checks with alternative independent variables

The study constructs an index for CEO power, which is the sum of three CEO-power dummy proxies: CEO pay slice (Cpower_D), CEO duality, and board independence. This approach enhances the credibility of our CEO power measure by ensuring that it reflects various dimensions of CEO power rather than relying on a single metric.

The study constructs an index for CEO power, which is the sum of three CEO-power dummy proxies: CEO pay slice (Cpower_D), CEO duality, and board independence. The board independence dummy (Board_INDEP_%) takes the value of one if the percentage of independent directors on that firm's board is lower than the sample median and zero otherwise. Noticeably, lower board independence is claimed to be associated with higher CEO power since it determines board effectiveness. Secondly, Cpower_D is a dummy variable equal to one if the CEO pay slice (CPS) is above the median value of the sample and zero otherwise. Lastly, CEO duality (CEO_DUAL) is a dummy variable denoting unity if the firm's CEO and chairperson roles are held by the same person and zero otherwise. Therefore, by taking the sum of these three dummies. The CEO power index is an ordinary variable that takes 0, 1, 2 and 3 values. The higher the index, the higher the CEO power.

- **CEO Pay Slice (Cpower_D):** The CEO pay slice captures the economic aspect of CEO power. A higher pay slice suggests that the CEO significantly influences compensation structures, which can translate into increased decision-making authority and operational control (Frydman & Jenter, 2010). CEOs receiving a larger share of total compensation often reflects their dominance in the executive hierarchy and ability to negotiate favourable terms. This metric directly indicates the CEO's financial clout and its implications for organisational priorities and risk appetite. This aspect is built on our main proxy for CEO power (see Chapter 2, Section 4c for more justification)

- **CEO Duality (CEO_DUAL):** CEO duality reflects the consolidation of power when one individual occupies both the CEO and chairperson roles. This arrangement can diminish the board's effectiveness in monitoring and providing checks on the CEO's actions (Lewellyn & Muller-Kahle, 2012). While some argue that duality can lead to more streamlined decision-making, it often raises concerns about governance failures and potential conflicts of interest (Li & Tang, 2010). As a proxy for CEO power, duality illustrates how leadership roles can be structured to enhance or limit oversight and accountability.
- **Board Independence (Board_INDEP_%):** Board independence is another critical measure of governance effectiveness. A higher proportion of independent directors on a board typically indicates more robust oversight capabilities and a greater ability to challenge the CEO's decisions (Fama & Jensen, 1983). Conversely, when the board is less independent, it can lead to an environment where the CEO wields disproportionate power, often resulting in decisions that may not align with shareholder interests (Bebchuk & Fried, 2004). Therefore, this proxy is essential for assessing how governance structures can either empower or constrain CEO authority.

iii. Robustness checks with alternative model estimation approaches

While cluster standard error can effectively address heteroskedasticity and autocorrelation, these statistical issues do not lead to biased coefficients. In contrast, the endogeneity issue in regression can result in biased estimates, which can significantly impact the study's conclusions. Endogeneity arises when the error terms correlate with the model's independent variables (Stock & Watson, 2003). There are three sources of endogeneity: simultaneity, omitted variables, and measurement errors. The numerical value or directional relation of endogenous variables is determined by their correlation with other variables (Roberts & Whited, 2013). In other words, endogenous variables indicate whether a variable is correlated or causes a particular effect. For instance, simultaneity bias occurs when one or more factors are determined in equilibrium, making it plausible to argue that either factor has the same effect (Roberts & Whited, 2013). Omitted variables refer to any variables that should be included in the direction of explanatory variables but, for various reasons, are not (Roberts & Whited, 2013). For example, the years of experience of newly appointed CEOs at the firm under investigation is an endogenous variable because newly appointed CEOs have zero experience in that firm. Measurement errors refer to proxies used for any difficulties in quantifying or observing variables. Such errors in quantifying variables may lead to measurement errors (Roberts & Whited, 2013).

Consequently, to tackle this problem, five estimation models are employed, including the lagged approach and fixed/random effect, the system General Method of Moment (GMM), the instrumental 2-stage least square (2SLS) approach, and the propensity score matching (PSM) approach. First, the lagged approach aims to tackle the issue of simultaneity (reverse causality) by using 1-year lagged independent variables (Chen, 2014). The rationale behind this approach is that this year's explanatory factors cannot affect a firm's risk level in the previous year. The fixed effect is employed if the model is exposed to unobservable variables that do not change over time (time-invariant) (Chen, 2014). The random effect model is more appropriate if the unobservable variables change over time. The choice between fixed and random effects will be based on the Hausman test (Guggenberger, 2010). Generally, this approach helps when the variable omission is the source of endogeneity.

Furthermore, the characteristics of a high-power CEO may exhibit distinct patterns and are different from those of a low-power CEO group. Those differences can be attributed to the firm risk rather than the power of the CEO per se. Therefore, the PSM method may tackle selection bias, another source of endogeneity (Abdul-Rahaman et al., 2021). Note that the main independent variable (CPS), denoted as a percentage (%), will be converted to a dummy variable to perform this estimation approach. This dummy will take a value of one if the firm’s CPS is higher than the industry median (i.e., firm run by powerful CEOs) and zero otherwise (i.e. firms run by non-powerful CEOs). Lastly, the system GMM and 2SLS approaches will be performed, having been claimed to tackle all three sources of endogeneity (Ullah et al., 2018; Gretz & Malshe, 2019).

g. Additional analyses: CEO power and firm risk during financial and health crises

To examine the differences in the relationship between CEO power and firm risk across financial and non-financial crises and COVID and non-COVID periods, two approaches are employed, which will be discussed as follows:

i. Difference-in-different approach

A difference-in-difference (DiD) approach will also be employed. The CEO power variable (CPS) will be converted to a dummy variable (Cpower_D). This dummy will take a value of unity if the firm's CPS is higher than the industry median (i.e., firm run by powerful CEOs) and zero otherwise (i.e. firms run by non-powerful CEOs). An interaction term between the CPS dummy and the COVID dummy (Cpower_Covid) and between the CPS dummy and the financial crisis dummy (Cpower_Crisis) will be included in the baseline OLS equation 3 (see equation 7):

$$TR_{i,t}/Risk\_Idio_{i,t}/Risk\_Sys_{i,t} = \alpha_{i,t} + \beta_1 * Cpower\_D_{i,t} + \beta_2 * Cpower\_Covid + \beta_3 * Crisis\_C + \beta_4 * Cpower\_Crisis + \beta_5 * Crisis\_F + \sum_{n=6}^{n=25} \beta_n * X_{n,i,t} + Year.FE + Firm.FE + Industry.FE + Country.FE + \epsilon_{i,t},$$

(eq. 7)

The DiD approach aims to examine the differences in a response variable (e.g., firm risk) across a group with treatment (e.g., firms run by powerful CEOs) and without treatment (e.g., firms run by non-powerful CEOs) over two different periods (e.g., financial crisis and health crisis).

ii. OLS cluster estimation on four sub-samples

The same OLS cluster regression as equation 3 (Section 4. e) will be performed separately on the financial, non-financial, COVID, and non-COVID samples. Subsequently, a Chow's test will be run to examine the differences in the coefficients of CEO power (CPS) across financial and non-financial crisis samples and covid and non-covid samples.

iii. Difference-in-different approach with Propensity score matching (PSM)

The study will employ a difference-in-difference (DiD) approach with PSM. This approach, similar to the DiD method, involves converting the CEO power variable (CPS) into a dummy variable (Cpower_D). The dummy variable will indicate whether the firm's CPS is higher than the industry median (i.e., a firm run by powerful CEOs). An interaction term between the CPS dummy and the COVID dummy (Cpower_Covid) and between the CPS dummy and the financial crisis dummy (Cpower_Crisis) will be included in the baseline OLS equation 3 (see equation 9). This approach aims to observe any significant change in the relationship between CEO power and firm risk under different conditions.

$$TR_{i,t}/Risk\_Idio_{i,t}/Risk\_Sys_{i,t} = \alpha_{i,t} + \beta_1 * Cpower\_D_{i,t} + \beta_2 * Cpower\_COVID + \beta_3 * Cpower\_Crisis + \sum_{n=2}^{n=24} \beta_n * X_{n,i,t} + Year.FE + Industry.FE + Country.FE + \epsilon_{i,t},$$

(eq.9)

iv. CEO power-risk relationship across firms with different growth opportunities and research and development expenditure

The OLS cluster regression explained in equation 3 (see Section 4. e) will be performed separately across different characteristics/conditions of firms: high (low) growth opportunity and high (low) research and development intensity. For this purpose, firms will be categorised into firms with high growth opportunities, firms with low growth opportunities, firms with high R&D expenditures, and low R&D expenditures. This categorisation is essential to observe any significant change in the relationship between the CEO's power and firm risk across the growth and R&D expenditure spectrum. (Carline et al., 2021)

v. CEO power-risk relationship across non-financial and financial firms

The study will also perform the OLS cluster regression discussed in Equation 3 (see Section 4. e) separately across financial and non-financial firms. This categorisation is necessary to observe any significant change in the relationship between CEO power and firm risk in financial and non-financial firms. The results of this analysis will provide valuable insights into the impact of CEO power on firm risk in different sectors.

5. EMPIRICAL FINDINGS

a. Descriptive statistics

Table 2 illustrates descriptive statistics for all variables utilised in this study from 2006 through 2021. The table comprises a univariate analysis for each dependent, independent, and control variable. All variables are winsorised at a one per cent level to reduce the impact of any potential outliers on the employed variables, following Kim and Lu (2011). Total risk (TR), Idiosyncratic risk (Risk_Idio), and systematic risk (Risk_sys) exhibit a right-skewed distribution. Hence, log transformations were employed for all these variables, following Sheikh (2019). The three variables have average values of -1.997, -2.007 and -2.289 and median values of 2.099, -2.155, and -2.299, respectively. The main independent variable, particularly the CEO pay slice (CPS), indicates that, on average, CEOs receive a total compensation package of around 25% of the total top five earning directors of companies. This is to say CEOs are commonly the highest earners among the top five earning directors. This statistic is similar to those in a study by Li, Gong, Zhang, and Koh (2018). Regarding control variables, the average CEO age was 63, ranging from 41 to 85. In recognition of the average

CEOs' gender, female CEOs represented around 5% of the firm-year observations. The average delta of CEOs' wealth was around 2.9, and the maximum delta was around 9. This indicates that on average, for every one percentage point increase in the stock price of the CEO's operating firms, their wealth (in dollar terms) would increase by three percentage points, i.e., triple the increase in the stock price. Besides, the average CEO tenure was around 1.3 years, with a median of 1.20 years, a minimum of 0 years (less than one year, newly appointed) and a maximum of 3 years. It also shows that more than half of the CEOs in the full sample have an education higher than a Master's (Mean $_{(CEO\_edu)}$ = 53.5%).

Regarding firm characteristics, the average firm size in the sample is 12.425 (log term), with a minimum value of 5.7 and a maximum value of 18.6. The average sales growth rate (Growth) was around 15%, while the median was around 9%. The average profitability was around -9%, while the median was 5%. The R&D variable has an average of 13%, signifying that firms, on average, spend around 13% of their total assets on research and development projects. The growth opportunity was the market-to-book ratio, with a mean of 2.86 and a median of 1.69. This implies that the market participants value the stock of the sampled firms 300% higher than their book values. This represents the trust and belief of the market investors in the future growth of firms. The tangibility of firms is measured by the proportion of total fixed assets to total assets. The average value was around 29%, i.e., 30% of firms' total assets are tangible assets such as plants, equipment, buildings, vehicles, etc. Next, leverage had an average value of 15.5% for the full sample and a median value of around 10%, ranging from 0% (for unleveled firms) to approximately 74.5%. Regarding cash surplus (cash_surp), it recorded an average value of 25% for the full sample and a dian value of around 15%. As shown in the results of the employed data, dividend cut was employed as a dummy variable to generate the value of unity if there was a reduction in annual dividend pay-out and zero otherwise. The mean value was 16.7%, indicating that 16.7% of firm-year observations show a dividend cut over one year. The median value of this variable is 0%. This reveals that firms are very cautious in implementing a dividend cut policy since the policy has a great market sensitivity due to the signalling effects of dividends.

Coming to board compositions, on average, firms appoint eight directors on the board with a median value of 7. As shown by the data utilised in this study, the average female representation was 10.7%, and the median was around 8%, which indicated the fraction of female directors on board generally. About the financial crisis, it was employed as a dummy variable to generate the value of one if the firm-year observations fell in the global financial crisis period between

2007 and 2009 or zero otherwise. In this study, the total number of observations was around 49,256, representing around 19% of the complete observations. For the current health crisis, the Covid variable (Crisis_C) was employed as a dummy variable to generate the value of one if the firm-year observations fell in the COVID-19 crisis during 2020 and 2021 or zero otherwise. The data shows that the total number of observations is 32,912, representing 13% of the whole sample.

Regarding GDP Growth, Inflation Rate, Foreign Investment, and Trade as a percentage of GDP, based on 119,548 observations. GDP Growth has a mean of 1.052%, ranging from -9.396% to 6.869%. Inflation shows moderate variation, with a mean of 1.785% and a range from -2.312% to 5.348%. Foreign Investment averages 2.275%, with high variability, ranging from -1.17% to 11.929%. Lastly, Trade (% of GDP) has the highest mean of 42.208%, showing considerable differences across economies, with a minimum of 23.376% and a maximum of 88.434%.

Table 2: Variable Descriptive Statistics for Full Sample

Table 2 provides the descriptive statistics of all variables employed in the study. ***TR*** refers to the firm total risk measured by the natural logarithm of the standard deviation of the individual firm's daily stock returns yearly, ***Risk_Idio*** refers to the firm idiosyncratic risk measured by the natural logarithm of standard deviation of the residuals obtained from the single-index market model and, ***Risk_Sys*** refers to the market risk measured by the natural logarithm of the difference between TR and Risk_Idio. **CPS** captures the percentage of the CEO's total compensation to the total compensation of the top five executives in each firm. ***CEO_Age*** biological age of the CEO (in years). ***CEO_ female*** denotes one if the CEO is female and 0 otherwise. ***Delta is*** the natural logarithm of the change in dollar value of CEOs' wealth for a one percentage point change in stock price. ***CEO_Tenure*** is the natural logarithm of the number of years the CEO has held the position. ***CEO_Edu*** 1 if the CEO has a master's degree or above or 0 otherwise. ***Size*** refers to the logarithm of the firm total assets. ***Growth*** captures % annual growth rate in sales. ***Profit is*** the ratio of earnings before interest payments and income taxes to total assets. ***R&D%*** research and development expenses to total assets. ***Growth_oppo*** Market-to-book ratio. ***CAPEX*** captures % of net fixed assets to total assets. ***Div_cut*** dummy one if there is a reduction in annual dividend payout and 0 otherwise. ***Board_size*** is the number of directors on the firm board of directors. ***% Female*** the fraction of female directors on board. ***Financial and Covid crisis*** one if the firm-year observations fall in 2007-2009 and 2020-2021, respectively, and 0 otherwise. ***GDP_growth*** measures the countries' % GDP growth (economic growth), and Inflation_rate is the % annual change in the countries' consumer price index (CPI). ***Foreign_Inv*** measures the % of foreign direct investment in the countries' GDP, and ***Trade (% of GDP)*** measures the percentage of the countries' trade in their GDP.

Variable	N	Mean	p50	Std.Dev	Min	Max
TR	250956	-1.997	-2.099	.417	-2.303	.178
Risk_Idio	250610	-2.007	-2.115	.418	-2.303	.177
Risk_Sys	250610	-2.289	-2.299	.022	-2.303	-2.186
CPS	75537	.241	0.222	.137	0	.75
CEO_Age	252493	63.456	63.800	9.023	41	85.111
CEO_ female	119806	.049	0.000	.215	0	1
Delta	76848	2.914	2.226	2.345	0	8.543
CEO_Tenure	263532	1.287	1.194	.746	0	3.199
CEO_Edu	99867	.535	1.000	.499	0	1
SIZE	239488	12.435	12.473	2.603	5.681	18.553
Growth	222624	.145	0.088	.44	-1.222	2.19
Profit	232304	-.088	0.048	.504	-3.315	.417
R&D %	128272	.133	0.030	.27	0	1.797

Growth_oppo	233888	2.869	1.690	7.286	-26.49	48.35
CAPEX	234496	.289	0.413	.839	-5.713	.997
Leverage	237264	.155	0.099	.172	0	.745
Cash_surp	127024	.25	0.149	.283	-.119	.961
Div_cut	136902	.167	0.000	.373	0	1
Board_size	239020	8.04	7.333	3.102	3	18.571
% Female	263532	.107	0.083	.121	0	.5
Crisis_F	49256	.187	0.000	.39	0	1
Crisis_C	32912	.125	0.000	.331	0	1
GDP_ Growth	119548	1.052	1.880	2.62	-9.396	6.869
Inflation_Rate	119548	1.785	1.850	.955	-2.312	5.348
Foreign_ Inv	119548	2.275	1.761	1.987	-1.17	11.929
Trade (% of GDP)	119548	42.208	30.790	17.45	23.376	88.434

N.B: The Observation (N) is for each variable, which can differ from the observation of the regressions due to missing data once all variables are included in an estimation model.

Table 3: Pairwise correlations matrix

Table 3 presents the correlation between all the variables analysed in this study. Bold coefficients signify statistically significant correlations at a 5% critical level or below.
Definitions for variables in Table are provided in sections 4. b and 4. c. The sample period ranges from 2006 to 2021.

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**	**(19)**	**(20)**	**(21)**	**(22)**	**(23)**
(1) CPS	1.000																						
(2) CEO_Age	**-0.008**	1.000																					
(3) CEO_ female	**-0.071**	**-0.086**	1.000																				
(4) Delta	**0.348**	**0.089**	**-0.127**	1.000																			
(5) CEO_Tenure	**0.075**	**0.317**	**-0.049**	**0.164**	1.000																		
(6) CEO_edu	**0.058**	**0.019**	0.004	**0.190**	**-0.013**	1.000																	
(7) SIZE	**0.157**	**0.179**	**-0.006**	**0.586**	**0.113**	**0.033**	1.000																
(8) Growth	**-0.029**	**-0.100**	**-0.011**	**-0.044**	**-0.118**	**0.010**	**-0.120**	1.000															
(9) Profit	**0.028**	**0.121**	**-0.006**	**0.225**	**0.163**	**-0.045**	**0.468**	**-0.075**	1.000														
(10) R&D %	**-0.034**	**-0.122**	**0.014**	**-0.125**	**-0.148**	**0.108**	**-0.388**	**0.071**	**-0.652**	1.000													
(11) Growth_oppo	**0.011**	**-0.075**	**0.008**	**0.111**	**-0.064**	**0.026**	**-0.060**	**0.039**	**0.007**	**0.032**	1.000												
(12) CAPEX	**-0.027**	**0.075**	**0.021**	**-0.012**	**0.126**	**0.022**	**0.173**	**-0.026**	**0.505**	**-0.495**	**0.063**	1.000											
(13) Leverage	**0.025**	**0.070**	**-0.022**	**0.054**	**0.044**	**-0.023**	**0.327**	**-0.066**	**0.147**	**-0.209**	**-0.108**	**-0.109**	1.000										
(14) Cash_surp	-0.002	**-0.205**	**0.017**	**-0.017**	**-0.148**	**0.126**	**-0.342**	**0.138**	**-0.350**	**0.449**	**0.108**	**-0.098**	**-0.440**	1.000									
(15) Div_cut	**-0.026**	**0.015**	**0.037**	**-0.084**	**0.042**	**-0.048**	**0.162**	**-0.135**	**0.098**	**-0.116**	**-0.046**	**0.015**	**0.114**	**-0.146**	1.000								
(16) Board_size	**0.213**	**0.194**	**-0.025**	**0.635**	**0.069**	**0.052**	**0.675**	**-0.097**	**0.222**	**-0.184**	**-0.014**	0.001	**0.142**	**-0.206**	**0.084**	1.000							
(17) % Female	**0.034**	**-0.168**	**0.295**	**0.183**	**-0.046**	**0.030**	**0.205**	**-0.030**	**0.050**	**0.019**	**0.036**	**-0.034**	0.003	**0.023**	**0.083**	**0.203**	1.000						
(18) Crisis_F	**-0.010**	**0.023**	**-0.021**	**-0.015**	**-0.006**	**-0.007**	**-0.012**	**-0.010**	**-0.007**	**0.009**	-0.003	-0.002	**0.015**	0.001	**0.023**	0.002	**-0.034**	1.000					
(19) Crisis_C	0.005	**-0.047**	**0.050**	-0.003	0.003	0.003	**0.034**	**-0.025**	**0.004**	**-0.019**	-0.002	**0.012**	**0.012**	0.005	**0.062**	**-0.014**	**0.062**	**-0.129**	1.000				
(20) GDP_ Growth	**0.043**	**0.163**	**-0.057**	**0.137**	**0.018**	**0.025**	**0.033**	**0.125**	**0.041**	-0.003	**0.029**	**0.008**	**-0.033**	**-0.009**	**-0.169**	**0.071**	**-0.159**	**-0.275**	**-0.755**	1.000			
(21) Inflation_Rate	**-0.064**	**0.112**	**0.034**	**-0.153**	**-0.027**	**-0.016**	**-0.119**	**0.095**	**0.009**	0.005	**0.018**	**0.018**	**-0.043**	0.001	**-0.054**	**-0.070**	**-0.069**	**0.007**	**0.053**	0.001	1.000		
(22) Foreign_ Inv	**-0.130**	**0.061**	**0.007**	**-0.264**	**-0.043**	**-0.070**	**-0.146**	**0.058**	**-0.028**	0.000	0.005	**0.011**	**-0.038**	**-0.046**	**-0.030**	**-0.152**	**-0.127**	**0.139**	**-0.157**	**0.197**	**0.156**	1.000	
(23) Trade (% of GDP)	**-0.245**	**-0.159**	**0.052**	**-0.726**	-0.003	**-0.132**	**-0.191**	-0.004	**-0.050**	**-0.031**	**-0.024**	**0.038**	**-0.020**	**-0.114**	**0.112**	**-0.238**	**0.028**	**-0.034**	**0.009**	**-0.111**	**-0.042**	**0.295**	1.000

Table 3 reveals the Pearson correlation matrix between the employed independent variables. As can be seen from the table, most correlation pairs are within the weak zone (< 0.5) with a few exemptions. These are Profitability and CAPEX (0.505), Size and CEO Delta (0.586), board size and delta (0.635), board size and growth opportunity (0.675), and GDP growth and Covid crisis (-0.755). The positively correlated value of profitability and CAPEX can be explained by the fact that when firms achieve higher profitability, they tend to reinvest their earned returns for future growth on fixed assets. Additionally, the positive relationship*s* between firm size and CEO delta and board size and CEO delta may be because larger firms and firms with bigger boards provide better compensation packages and incentive packages for CEOs, which are linked to the firm stock performance. Furthermore, a positive correlation between board size and growth opportunity supports the literature on the efficiency of bigger boards, which enhances the growth opportunity of the firms (Dalton R. et al., 1999). Lastly, regarding GDP Growth and the COVID crisis, it is apparent that the correlation is coincident since the COVID crisis dummy is determined by the years but not other natures of the crisis.

According to Sharma (2005), any correlation value higher than 0.8 indicates a concern of multicollinearity in the analysed data. In this present study, the highest correlation was around 75%. Therefore, multicollinearity is not a concern. To be more assured, additional Variance Inflation Factor (VIF) tests are employed when running regressions, and all returned VIF values are less than 10. This once again confirms that the multicollinearity issue is not too much of a concern with the employed dataset.

b. *Main findings: Baseline OLS cluster estimation*

i. *CEO power and firm risk: Baseline OLS cluster at firm level.*

Table 4 shows the results of the baseline estimation model (Section 4. e, eq. 3) that was performed using the Ordinary Least Squares (OLS) with clustered standard error at the firm level. First, the relationship between CEO power and total risk (TR) is captured in Columns 1-4. These represent four variation models. The first variation model includes solely CEO power as the main independent variable with year, industry, and country fixed effects. The second variation model further considers other CEOs' characteristics as controlling variables. These are CEOs' age, gender, delta, tenure, and education. The third variation model additionally controls firms' specific characteristics and their boards' characteristics, including firm size, sales growth, profitability, R&D expense, growth opportunity, asset tangibility, surplus cash, dividend cut, board size, and female directors on board. The last variation model is the full model that contains all variables described in Sections 4. c and 4.d: CEO characteristics, firm characteristics, board characteristics, and microeconomics variables. The adjusted R-squared increases across the four model variations, and the highest value is obtained for the last full model (column 4), where all other variables were included. Therefore, the finding is interpreted based on this full model. Subsequently, the last two columns (Columns 5-6) of Table 3 reveal the results on the relationship between CEO power and the two components of total risk, i.e., the idiosyncratic risk (Risk_Idio) and systematic risk (Risk_Sys), respectively. These two models contain all variables, as included in the full model of total risk (Column 4).

As can be seen from Table 3, the coefficient β_1 of the CEO power variable (CPS) (See eq.3, Section 4. e) shows a positive value of 0.146, 0.18, 0.093, and 0.092 for the four model variations (Columns 1-4), respectively. All these coefficients are statistically significant at a 1% level or below. This indicates a consistent finding on the positive relationship between CEO power and firm total. Particularly, every one per cent increase in CEO power (measured by a 1% increase in the CEO's pay relative to the total pay of the top five directors) would be associated with an approximately 10% increase in the firm total risk. This supports Hypothesis 1 (Section 3.c) as expected. Consistent with the findings obtained by Sheikh (2019) and Lewellyn and Muller-Kahle (2012). An explanation for this positive relationship is that CEOs who are given more power tend to be more confident and optimistic about their decision-making, and at the same time, they tend to overlook and underestimate any downside risk associated with their decisions (Anderson & Galinsky, 2006). This justification is built on the approach/inhibition theory of power (Keltner et al., 2003)

Regarding the decomposition of total risk into idiosyncratic risk and systematic risk, the results revealed in Columns 5-6 indicate that the positive influence of CEO power on firm risk is mainly driven by its influence on firm-specific risk rather than on market risk. This can be drawn from the economic significance of the CEO power relationship with the two risk components. Particularly, although both coefficients are statistically significant at 5% or below (β_1 = 0.89 and 0.007, Columns 5-6, respectively), the magnitude of the coefficient in the idiosyncratic risk model is much higher than that in the systematic risk and is closer to that of the total risk model. The idiosyncratic risk refers to the risk that is borne by decisions made by firms and is related exclusively to each firm, whilst the systematic risk relates to market-borne factors independent from the firm strategies and decisions. It can be understandable that a powerful CEO can often influence and have great control over the firm's strategic decision-making processes and, hence, alter the overall risk level of that firm. However, the power of CEOs seems to hardly affect market-borne risks. This may be why the study of Sheikh (2019) only focused on the risk in their study.

Regarding control variables, the analysis showed that firm total risk is negatively affected by CEO delta, CEO tenure, firm size, profitability, and dividend cut policy. However, it is positively affected by firm leverage and tends to be higher during crises. The literature supports these findings (Yung & Chen, 2018; Sila et al., 2016).

Table 4: Influences of CEO power on firm risk – The baseline estimation model

Table 4 presents the results of the estimation of baseline methods (OLS) with clustered standard error at the firm level from 2006 through 2021. The dependent variables are total risk (TR), presented in columns 1-4; idiosyncratic risk (Risk_idio), presented in column 5; and systematic risk (Risk_Sys), presented in column 6. ***TR*** refers to the firm total risk measured by the natural logarithm of the standard deviation of the individual firm's daily stock returns yearly, ***Risk_Idio*** refers to the firm idiosyncratic risk measured by the natural logarithm of standard deviation of the residuals obtained from the single-index market model and, ***Risk_Sys*** refers to the market risk measured by the natural logarithm of the difference between TR and Risk_Idio. **CPS** captures the percentage of the CEO's total compensation to the total compensation of the top five executives in each firm. ***CEO_Age*** biological age of the CEO (in years). ***CEO_female*** denotes one if the CEO is female and 0 otherwise. ***Delta is*** the natural logarithm of the change in dollar value of CEOs' wealth for a one percentage point change in stock price. ***CEO_Tenure*** is the natural logarithm of the number of years the CEO has held the position. ***CEO_Edu*** 1 if the CEO has a master's degree or above or 0 otherwise. ***Size*** refers to the logarithm of the firm total assets. ***Growth*** captures % annual growth rate in sales. ***Profit is*** the ratio of earnings before interest payments and income taxes to total assets. ***R&D%*** research and development expenses to total assets. ***Growth_oppo*** Market-to-book ratio. ***CAPEX*** captures % of net fixed assets to total assets. ***Div_cut*** dummy one if there is a reduction in annual dividend payout and 0 otherwise. ***Board_size*** is the number of directors on the firm board of directors. ***% Female*** the fraction of female directors on board. ***Financial and Covid crisis*** one if the firm-year observations fall in 2007-2009 and 2020-2021, respectively, and 0 otherwise. ***GDP_growth*** measures the countries' % GDP growth (economic growth), and Inflation_rate is the % annual change in the countries' consumer price index (CPI). ***Foreign_Inv*** measures the % of foreign direct investment in the countries' GDP, and ***Trade (% of GDP)*** measures the percentage of the countries' trade of their GDP. P-values in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% critical levels, respectively.

Variable	(1) TR	(2) TR	(3) TR	(4) TR	(5) Risk_Idio	(6) Risk_Sys
CPS	.146***	.18***	.093***	.092***	.089**	.007***
	(0.00)	(0.00)	(.008)	(.008)	(.011)	(.001)
CEO_Age		-.002***	0.0003	0.0003	0.0004	0.00003
		(0.00)	(.495)	(.519)	(.49)	(.376)
CEO_ female		-.093***	-.005	-.007	-.007	.001
		(0.00)	(.686)	(.565)	(.547)	(.569)
Delta		-.035***	-.013***	-.013***	-.013***	-.001***
		(0.00)	(0.00)	(0.00)	(0.00)	(.003)
CEO_Tenure		-.015***	-.012***	-.012***	-.013***	-.00009
		(0.00)	(.01)	(.009)	(.006)	(.816)
CEO_Edu		.001	.01	.009	.009	0.0002
		(.822)	(.185)	(.197)	(.208)	(.671)
SIZE			-.043***	-.043***	-.048***	.004***
			(0.00)	(0.00)	(0.00)	(0.00)
Growth			-.01	-.009	-.01	0.0002
			(.47)	(.506)	(.481)	(.527)
Profit			-.164***	-.164***	-.163***	-.002**
			(0.00)	(0.00)	(0.00)	(.046)
R&D %			-.008	-.009	-.015	.003
			(.908)	(.896)	(.83)	(.21)
Growth_oppo			-.001	-.001	-.001	0.00006*
			(.102)	(.133)	(.105)	(.066)
CAPEX			-.024	-.025	-.025	-.001**
			(.303)	(.274)	(.289)	(.033)
Leverage			.169***	.168***	.178***	-.006*
			(.001)	(.001)	(0.00)	(.067)
Cash_surp			-.053	-.053	-.059*	.004**
			(.128)	(.134)	(.099)	(.01)
Div_cut			-.04***	-.042***	-.045***	.003***
			(0.00)	(0.00)	(0.00)	(0.00)
Board_size			.001	.001	.001	-.0001
			(.51)	(.557)	(.417)	(.357)
% Female			-.12***	-.119***	-.109**	-.009***
			(.008)	(.009)	(.017)	(.006)
Crisis_F			.152***	.246***	.219***	.033***
			(0.00)	(0.00)	(0.00)	(0.00)
Crisis_C			.137***	.2***	.183***	.016***
			(0.00)	(0.00)	(.001)	(0.00)
GDP_ Growth				.008	.006	.001***
				(.182)	(.29)	(0.00)
Inflation_Rate				.021***	.022***	-.001
				(.004)	(.003)	(.301)

Foreign_ Inv				-.001	-.001	.001***
				(.787)	(.561)	(0.00)
Trade (% of GDP)				.005***	.004***	.001***
				(.004)	(.01)	(0.00)
Constant	-2.003***	-1.675***	-1.227***	-1.608***	-1.492***	-2.429***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed	Yes	Yes	Yes	Yes	Yes	Yes
Observations	35267	27887	12836	12836	12685	12685
R-squared	0.105	0.142	0.250	0.251	0.263	0.464
F-statistic	52.808	42.017	21.255	32.699	26.238	60.48

ii. Robustness Check: Alternative estimation models

To ensure the findings obtained above by the baseline estimations, the fixed effect model and lagged approach are employed to deal with endogeneity issues. The results of these two models are presented in Table 5, with Panel A for the fixed effect model and Panel B for the lagged approach. First, the fixed effect is employed to deal with any unobservable variables that are constant over time (time-invariant). On the other hand, the random effect model is more appropriate for unobservable variables whose values change over time. In order to identify the choice between fixed effect and random effect models, the Hausman test is employed (Baltagi et al., 2003). The Hausman test helps deal with the source of omission variable endogeneity. As seen in Table 4 (Panel A, columns 1-3), all Hausman tests yield statistically significant Chi-square values, indicating that the fixed effect model should be used rather than the random effect model. Second, the lagged approach aims to manage the simultaneity (reverse causality) issue of endogeneity by utilising 1-year lagged independent variables. The rationale is simply that future events cannot influence an event that has already happened in the past. Particularly, the explanatory factors in the model, e.g., CEO power, last year (year t-1), can hardly be affected by the dependent variable, e.g., firm risk, of the current year (year t).

Consistent with the findings of the baseline method, the fixed effect and lagged models show that the CEO power is significantly positively associated with all three risks: total risk, idiosyncratic risk and systematic risk. Particularly, for the total risk, a 1% increase in CEO power tends to cause the total risk to increase by roughly 10%. Again, this effect is mainly driven by the influence of CEO power on idiosyncratic risk, which is increased similarly for every 1% increase in CEO power in terms of economic significance. Under the employment of different estimation methods, the findings remain the same, and hypothesis 1 is supported.

Lastly, the author employed a two-step Generalized Method of Moments (GMM) estimator as another robustness estimation. As stated above in this section, the fixed effect is tackled with time-invariant omitted variables, and the lagged approach deals with the reverse causality of endogeneity. GMM, on the other hand, is employed to tackle all three varieties of endogeneity (Trinh et al., 2020; Ullah et al., 2018; Mollah & Zaman, 2015). The result is reported in the panel C of Table 5. The model has the first autocorrelation test, which is statistically significant. However, since the robust option is employed, this cannot confirm the autocorrelation issue. According to the second-order autocorrelation test (AR2), the test statistic is insignificant, ruling out the concern of autocorrelation. Additionally, the Hansen test for overidentification issues provides insignificant statistics for all models. Therefore, it indicates the appropriateness of the instrumental variables employed in the model.

As shown by the results of the GMM model, the CEO pay slice (CEO power) recorded positive significant coefficients across all tested GMM models. Higher CEO power is expected to lead to higher firm risk. This finding is consistent with the findings of the baseline method, fixed effect, and lagged approach. The power-risk relationship is consistently pronounced for the idiosyncratic risk, while the effect on systemic risk is economically less significant. Particularly for the total and idiosyncratic risks, a 1% increase in CEO power tends to cause these risks to increase by almost 7% and 4.5%, respectively. For the systematic risk, the marginal effect is only 0.5%.

Overall, the three alternative estimation models presented in this section tackle the endogeneity issue, assure and confirm the findings obtained by the OLS baseline models, and support the positive relationship between CEO power and risk.

Table 5: Robustness check using alternative estimation models

Table 5 presents the results of the robustness check using three alternative approaches taking into account the endogeneity problems: the Fixed effect model (Panel A), the lagged approach (Panel B) and GMM (Panel C). The dependent variables are total risk (TR), presented in columns 1-4 and 7; idiosyncratic risk (Risk_idio), presented in columns 2-5 and 8; and systematic risk (Risk_Sys), presented in columns 3-6 and 9. ***TR*** refers to the firm total risk measured by the natural logarithm of the standard deviation of the individual firm's daily stock returns yearly, ***Risk_Idio*** refers to the firm idiosyncratic risk measured by the natural logarithm of standard deviation of the residuals obtained from the single-index market model and, ***Risk_Sys*** refers to the market risk measured by the natural logarithm of the difference between TR and Risk_Idio. **CPS** captures the percentage of the CEO's total compensation to the total compensation of the top five executives in each firm. ***CEO_Age*** biological age of the CEO (in years). ***CEO_ female*** denotes one if the CEO is female and 0 otherwise. ***Delta is*** the natural logarithm of the change in dollar value of CEOs' wealth for a one percentage point change in stock price. ***CEO_Tenure*** is the natural logarithm of the number of years the CEO has held the position. ***CEO_Edu*** 1 if the CEO has a master's degree or above or 0 otherwise. ***Size*** refers to the logarithm of the firm total assets. ***Growth*** captures % annual growth rate in sales. ***Profit is*** the ratio of earnings before interest payments and income taxes to total assets. ***R&D%*** research and development expenses to total assets. ***Growth_oppo*** Market-to-book ratio. ***CAPEX*** captures % of net fixed assets to total assets. ***Div_cut*** dummy one if there is a reduction in annual dividend payout and 0 otherwise. ***Board_size*** is the number of directors on the firm board of directors. ***% Female*** the fraction of female directors on board. ***Financial and Covid crisis*** one if the firm-year observations fall in 2007-2009 and 2020-2021, respectively, and 0 otherwise. ***GDP_growth*** measures the countries' % GDP growth (economic growth), and Inflation_rate is the % annual change in the countries' consumer price index (CPI). ***Foreign_Inv*** measures the % of foreign direct investment in the countries' GDP, and ***Trade (% of GDP)*** measures the percentage of the countries' trade of their GDP. P-values in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% critical levels, respectively.

	Panel A: Fixed Effect			Panel B: Lagged Approach			Panel C: GMM		
Variable	**(1) TR**	**(2) Risk_Idio**	**(3) Risk_Sys**	**(4) TR**	**(5) Risk_Idio**	**(6) Risk_Sys**	**(7) TR**	**(8) Risk_Idio**	**(9) Risk_Sys**
L1	-	-	-	-	-	-	0.272***	0.284***	-0.199*
	-	-	-	-	-	-	(0.001)	(0.001)	(0.085)
CPS	.098***	.099***	.004**	.082***	.085***	.006***	0.0689**	0.0448*	0.00477**
	(.008)	(.008)	(.043)	(.009)	(.007)	(.005)	(0.020)	(0.051)	(0.014)
CEO_Age	.001**	.001*	0.00004*	0.0003	0.0003	0.00001	0.000254	0.000483	0.0000706
	(.038)	(.056)	(.086)	(.546)	(.525)	(.695)	(0.590)	(0.319)	(0.198)
CEO_ female	-.007	-.011	.002**	.002	.001	0.0002	-0.00797	-0.00161	-0.000381
	(.539)	(.364)	(.048)	(.862)	(.967)	(.84)	(0.372)	(0.836)	(0.794)
Delta	-.013**	-.013***	-0.0002	-.009***	-.012***	-.001***	-0.0143**	-0.00593***	-0.000343
	(0.00)	(0.00)	(.206)	(0.00)	(0.00)	(.001)	(0.021)	(0.001)	(0.215)
CEO_Tenure	-.007	-.006	0.0002	-.012***	-.012***	-0.000002	-0.00173	-0.00527*	-0.000208
	(.128)	(.153)	(.436)	(.003)	(.003)	(.995)	(0.627)	(0.083)	(0.710)
CEO_Edu	.002	.002	-0.0002	.009	.009	0.00005	0.00621	0.0105	0.00921
	(.803)	(.755)	(.525)	(.189)	(.18)	(.925)	(0.758)	(0.594)	(0.466)
SIZE	-.056***	-.064***	.003***	-.04***	-.044***	.004***	-0.0183***	-0.0225***	0.00459***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.000)	(0.000)	(0.000)
Growth	-.024**	-.025**	-0.0004	-.004	-.005	.001	-0.00537	-0.00866	0.000105
	(.045)	(.039)	(.362)	(.726)	(.7)	(.101)	(0.579)	(0.372)	(0.889)
Profit	-.05*	-.061**	-.001	-.16***	-.159***	-.001	-0.141***	-0.149***	-0.00270**
	(.077)	(.034)	(.284)	(0.00)	(0.00)	(.243)	(0.000)	(0.000)	(0.039)
R&D %	-.168*	-.168*	-.003	-0.0002	-.006	.004*	0.0185	0.0109	0.00227

	(.054)	(.056)	(.292)	(.998)	(.93)	(.053)	(0.715)	(0.832)	(0.451)
Growth_oppo	-.001	-.001	0.00007**	-0.0004	-0.0004	0.00006*	-0.000108	-0.000206	0.0000541
	(.308)	(.221)	(.006)	(.298)	(.276)	(.065)	(0.722)	(0.516)	(0.242)
CAPEX	-.023	-.041	-.001	-.022	-.022	-.001*	-0.0305*	-0.0244	-0.00163*
	(.349)	(.329)	(.452)	(.263)	(.271)	(.096)	(0.072)	(0.131)	(0.068)
Leverage	.34***	.323***	-.003	.132***	.139***	-.006*	0.0611**	0.0774***	-0.00613
	(0.00)	(0.00)	(.391)	(.008)	(.005)	(.074)	(0.039)	(0.004)	(0.146)
Cash_surp	-.156***	-.155***	.001	-.054	-.061*	.005***	-0.0184	-0.0236	0.00450*
	(.001)	(.001)	(.552)	(.101)	(.07)	(.002)	(0.381)	(0.249)	(0.089)
Div_cut	-.011*	-.013**	.002***	-.039***	-.042***	.003***	-0.0143***	-0.0142***	0.00295***
	(.076)	(.033)	(0.00)	(0.00)	(0.00)	(0.00)	(0.008)	(0.004)	(0.001)
Board_size	-.002**	-.003**	-0.0001	0.0004	.001	-0.0001	0.000475	0.000725	-0.000286
	(.035)	(.011)	(.335)	(.69)	(.468)	(.32)	(0.548)	(0.338)	(0.174)
% Female	-.233***	-.219***	-.012***	-.102**	-.092**	-.009***	-0.00475	-0.0139	0.0134**
	(0.00)	(0.00)	(0.00)	(.015)	(.03)	(.003)	(0.900)	(0.701)	(0.035)
Crisis_F	.238***	.216***	.032***	.142***	.111***	.033***	-	-	-
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	-	-	-
Crisis_C	.254***	.229***	.018***	.205***	.155***	.051***	-	-	-
	(0.00)	(0.00)	(0.00)	(0.00)	(.001)	(0.00)	-	-	-
GDP_ Growth	.008*	.007	.001***	-0.0002	-.002	.002***	0.00514	0.00451	0.00141***
	(.078)	(.116)	(.001)	(.955)	(.632)	(0.00)	(0.151)	(0.176)	(0.001)
Inflation_Rate	.019***	.022***	-.001**	.022***	.024***	-.001	0.0105**	0.0116**	-0.000562
	(.002)	(0.00)	(.013)	(.002)	(.001)	(.218)	(0.042)	(0.019)	(0.382)
Foreign_ Inv	-.0001	-.001	.001***	-0.00008	-.001	.001***	0.000319	-0.000716	0.000927***
	(.919)	(.444)	(0.00)	(.96)	(.671)	(0.00)	(0.779)	(0.479)	(0.000)
Trade (% of GDP)	.007***	.007***	0.0003**	.006***	.005***	0.0004***	0.00241**	0.00198*	0.000508**
	(0.00)	(0.00)	(.025)	(.001)	(.001)	(.001)	(0.029)	(0.063)	(0.017)
Constant	-1.705***	-1.595***	-2.345***	-1.642***	-1.546***	-2.406***	-1.322***	-1.222***	-2.896***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.000)	(0.000)	(0.000)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	NO	NO	NO	Yes	Yes	Yes	Yes	Yes	Yes
country fixed effect	NO	NO	NO	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12836	12685	12685	13288	13129	13129	12836	12685	12685
R-squared	0.1669	0.1762	0.2949	0.245	0.258	0.447	-	-	-
F-statistic	37.505	23.303	49.291	24.075	21.696	56.292	-	-	-
Hausman test (Chi-square)	215.13***	177.62***	184.77***	-	-	-	-	-	-
AR (1) p_value	-	-	-	-	-	-	0.000	0.000	0.194
AR (2) p_value	-	-	-	-	-	-	0.199	0.221	0.171
Hansen-test (p_value)	-	-	-	-	-	-	0.286	0.413	0.297

iii. Robustness checks with alternative model estimation approach (2SLS)

We employ the instrumental 2-stage least square (2SLS) approach to address a potential endogeneity issue further. To implement this method, we adopt two instrumental variables: the median of CPS at the country and industry levels and CEO retirements (Fan et al., 2021; Chintrakarn et al., 2015). The two key criteria of an instrumental variable (IV) are that (1) the variable is exogenous and (2) significantly related to the investigated explanatory variable, i.e., firm risk. Other studies have employed the median value of CEO power (CPS) (Chintrakarn et al., 2015). The rationale is that the median CPS across each industry and each country is likely to be positively related to the CPS of the firm, which may be because of similar criteria of appointment of CEOs in that industry and in that country and a relative compensation (relative power) assigned to CEOs should be similar. At the same time, the CPS median value is not the firm's characteristics and, hence, is likely to be exogenous. We further employ the CEO retirement as another instrumental variable, which denotes one if the time to retirement age of the CEO is less than two years or negative, i.e., beyond the retirement age. This variable is exogenous because its key determinations are the country's retirement law and the biological age of the CEO. We predict that this factor is positively related to CEO power because the closer the time to retirement is, the more experience CEOs have as CEOs and in a corporate environment. Consequently, the higher power is accumulating.

In our regression analysis, we report the results of the 2SLS estimator in Table 6. In the first stage, we regress CEO power on the two IVs: retirement and CPS_med. As expected, the coefficients of CPS_med and CEO retirements are positive, but the latter is not statistically significant. In the second stage, we regress firm risk variables on fitted values obtained from the first-stage regressions. All results show a positive and significant impact of CEO power on firm risk and its components at the 1% level or below. These results remain consistent and unchanged compared to the main findings. Specifically, Table 5 confirms the validity of the chosen instrumental variables and reveals the presence of endogeneity problems. The reported results demonstrate that our main findings are robust across all models.

Table 6: Robustness check using alternative estimation model (2SLS)

Table 6 presents the results of the 2SLS approach from 2006 through 2021. The dependent variables are total risk (TR), presented in column 1; idiosyncratic risk (Risk_idio), presented in column 2; and systematic risk (Risk_Sys), presented in column 3. ***TR*** refers to the firm total risk measured by the natural logarithm of the standard deviation of the individual firm's daily stock returns yearly, ***Risk_Idio*** refers to the firm idiosyncratic risk measured by the natural logarithm of standard deviation of the residuals obtained from the single-index market model and, ***Risk_Sys*** refers to the market risk measured by the natural logarithm of the difference between TR and Risk_Idio. **CPS** captures the percentage of the CEO's total compensation to the total compensation of the top five executives in each firm. ***CEO_Age*** biological age of the CEO (in years). ***CEO_ female*** denotes one if the CEO is female and 0 otherwise. ***Delta is*** the natural logarithm of the change in dollar value of CEOs' wealth for a one percentage point change in stock price. ***CEO_Tenure*** is the natural logarithm of the number of years the CEO has held the position. ***CEO_Edu*** 1 if the CEO has a master's degree or above or 0 otherwise. ***Size*** refers to the logarithm of the firm total assets. ***Growth*** captures % annual growth rate in sales. ***Profit is*** the ratio of earnings before interest payments and income taxes to total assets. ***R&D%*** research and development expenses to total assets. ***Growth_oppo*** Market-to-book ratio. ***CAPEX*** captures % of net fixed assets to total assets. ***Div_cut*** dummy one if there is a reduction in annual dividend payout and 0 otherwise. ***Board_size*** is the number of directors on the firm's board of directors. ***% Female*** the fraction of female directors on board. ***Financial and Covid crisis*** one if the firm-year observations fall in 2007-2009 and 2020-2021, respectively, and 0 otherwise. ***GDP_growth*** measures the countries' % GDP growth (economic growth), and Inflation_rate is the % annual change in the countries' consumer price index (CPI). ***Foreign_Inv*** measures the % of foreign direct investment in the GDP of the countries, ***Trade (% of GDP)*** measures the percentage of the countries' trade of their GDP, ***Retirements*** 1 if the company has CEO's time to retirement is less than or equal to 2, and ***CPS_med*** is the median of value of CPS across each industry in each country. P-values in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% critical levels, respectively.

	2SLS		
Variable	**(1) TR**	**(2) Risk-Idio**	**(3) Risk-Sys**
First Stage			
Retirements		.0037311 (0.423)	
CPS_med		1.033567*** (0.000)	
Second Stage			
CPS	0.4598*** (0.000)	0.4000*** (0.000)	0.0663*** (0.000)
Constant	-1.5996*** (0.000)	-1.5033*** (0.000)	-2.3991*** (0.000)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
Chi_sq (p-value)	0.0000	0.0000	0.0000
F-test (p-value)	0.0000	0.0000	0.0000
Hansen overidentification (p-value)	0.1021	0.1146	0.7849
Observations	15752	15570	15570
R-squared	0.2244	0.2409	0.3733

iv. Robustness Check: Alternative dependent variables

To assure the findings obtained above by the baseline estimations. Another robustness check is conducted using three alternative measures of firm risk (the dependent variable) and clustered standard error at the firm level. These are the standard deviation of return on asset (STD-ROA), the bankruptcy risk (Z-score), and the accounting rate of return (ARR). The three measures are three risk outcomes of firms capturing different aspects of firm risk (Yung & Chen, 2018; Wang, 2011; Calandro, 2017; Rangan, 2008; and Pathan, 2009). Particularly, whilst the main measure of total risk (TR) focuses more on the fluctuation of stock values, i.e., the overall market value of shareholder's wealth, these three alternative measures of risk capture the accounting risk of firms. Their measures can be found in Section 4.f.i and Table 7. The results presented in Table 7 consistently confirm the main findings that CEO power is positively associated with firm risk. The standard deviation of ROA captures the fluctuation/variation of a firm's return on assets. The higher the STD-ROA, the higher the risk due to more unstable returns. The result shows that a 1% increase in CEO power would lead to an increase of 0.63 standard deviation point of STD-ROA (Table 5, column 1, $\beta_1 = 0.626$, p-value < 0.01). Similarly, the Z-score takes a reverse score, meaning the higher the value, the lower the risk. Therefore, a negative coefficient of -1.269, statistically significant at 5% level or below, indicates a positive relationship between CEO power and firm risk. The same finding once again is found for the last alternative risk measure, ARR (Table 5, column 3). Overall, this robustness test implies that firms that provide CEOs with more power tend to be exposed to higher risks from both book and market aspects.

Table 7: Robustness check using alternative dependent variables.

Table 7 presents the results of the robustness check using three alternative measures of firm risk using clustered standard error at the firm level. These are Std_ROA (column 1) measured by the standard deviation of the firm's return on asset over the last four years; Z-score (column 2) captured the bankruptcy risk calculated as ((3.3*EBIT)+(1*Net sales)+(1.4*Retained earnings)*(1.2*Working capital))+(0.6*equity market value/book value of total liabilitities)/Total Asset; and ARR (column 3) stands for Accounting rate of return which is calculated as the standard deviation of the firm's daily stock returns MULTIPLIES the ratio of market capitalisation to market value of total asset MULTIPLIES a square-root of 250. **CPS** captures the percentage of the CEO's total compensation to the total compensation of the top five executives in each firm. ***CEO_Age*** biological age of the CEO (in years). ***CEO_ female*** denotes one if the CEO is female and 0 otherwise. ***Delta is*** the natural logarithm of the change in dollar value of CEOs' wealth for a one percentage point change in stock price. ***CEO_Tenure*** is the natural logarithm of the number of years the CEO has held the position. ***CEO_Edu*** 1 if the CEO has a master's degree or above or 0 otherwise. ***Size*** refers to the logarithm of the firm total assets. ***Growth*** captures % annual growth rate in sales. ***Profit is*** the ratio of earnings before interest payments and income taxes to total assets. ***R&D%*** research and development expenses to total assets. ***Growth_oppo*** Market-to-book ratio. ***CAPEX*** captures % of net fixed assets to total assets. ***Div_cut*** dummy one if there is a reduction in annual dividend payout and 0 otherwise. ***Board_size*** is the number of directors on the firm board of directors. ***% Female*** the fraction of female directors on board. ***Financial and Covid crisis*** one if the firm-year observations fall in 2007-2009 and 2020-2021, respectively, and 0 otherwise. ***GDP_growth*** measures the countries' % GDP growth (economic growth), and Inflation_rate is the % annual change in the countries' consumer price index (CPI). ***Foreign_Inv*** measures the % of foreign direct investment in the countries' GDP, and ***Trade (% of GDP)*** measures the percentage of the countries' trade of their GDP. P-values in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% critical levels, respectively.

Variable	(1) STD-ROA	(2) Z-score	(3) ARR
CPS	.626***	-1.118**	2.319***
	(0.00)	(-2.293)	(0.00)
CEO_Age	.002	-0.001	.005
	(.517)	(-0.172)	(.678)
CEO_ female	-.047	-0.187	-.455
	(.478)	(-1.037)	(.131)
Delta	-.003	0.099	-.691***
	(.841)	(1.602)	(0.00)
CEO_Tenure	-.149***	-0.082	-.151
	(0.00)	(-0.949)	(.136)
CEO_Edu	-.089***	0.074	-.195
	(.01)	(0.626)	(.237)
SIZE	-.227***	0.292***	.333***
	(0.00)	(4.365)	(.001)
Growth	-.137***	0.040	-.993***
	(.01)	(0.127)	(0.00)
Profit	-.611***	12.129***	-3.016***
	(0.00)	(12.328)	(0.00)
R&D %	.406**	-4.922**	-3.144***
	(.026)	(-2.066)	(.005)
Growth_oppo	.001	0.008	-.045***
	(.666)	(0.751)	(0.00)
CAPEX	-.069	4.115***	-2.428***
	(.213)	(4.652)	(0.00)
Leverage	.748***	2.829***	27.803***
	(0.00)	(2.826)	(0.00)
Cash_surp	.524***	0.723	-3.097***
	(0.00)	(1.440)	(0.00)
Div_cut	.048	0.346***	.179
	(.207)	(3.652)	(.246)
Board_size	-.069***	-0.006	.025
	(0.00)	(-0.320)	(.51)
% Female	-.195	-0.668	-1.78*
	(.305)	(-0.824)	(.07)
Crisis_F	.055	0.267	3.469***
	(.779)	(0.427)	(0.00)
Crisis_C	.654***	0.150	2.041**
	(.005)	(0.244)	(.013)
GDP_ Growth	.016	0.025	.14*

	(.503)	(0.345)	(.073)
Inflation_Rate	-.046	-0.034	.202**
	(.157)	(-0.347)	(.048)
Foreign_ Inv	.006	0.032	.011
	(.494)	(1.038)	(.701)
Trade (% of GDP)	-.031***	-0.027	.055*
	(0.00)	(-1.042)	(.096)
Constant	6.927***	-4.389**	-29.168***
	(0.00)	(-2.319)	(0.00)
Year fixed effect	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes
Observations	12836	12664	12836
R-squared	0.272	0.599	0.507
F-statistic	56.657	18.82	113.003

v. Robustness Check: Alternative independent variables

Lastly, to ensure the findings obtained above by the baseline estimations. Another robustness check is implemented with alternative independent variables, i.e., CEO power, using clustered standard error at the firm level. The first alternative measure is the CEO duality (Lewellyn and Muller-Kahle hold 2012), which is projected that firms led by CEOs who are also the chairmen of the firms' boards, tend to exhibit greater power, in comparison to firms led by separate CEOs and Chairmen. The key reason is because CEO duality may mitigate the monitoring power and efficiency of the boards. The results are revealed in Table 8 (Panel A) for all three measures of risk. As can be seen, firms led by powerful CEO (proxied by dual CEO-chairman) expose to 2.2% higher risk than firms led by non-powerful CEO. This finding is statistically significant at 1% level or below. Consistently, this relationship is driven by idiosyncratic rather than systematic risk. This is to say, CEO power tend to primarily influence the firm-specific risk.

Secondly, firms' board independence level is employed as another alternative measure of CEO power, which capture the proportion of board members that are independent directors. This measure is a reverse proxy of CEO power such that a higher value of board independence the less power CEOs possess. This is because boards with more outside directors impose more monitoring to serve the best interests of shareholders (Lewellyn and Muller-Kahle, 2012). As presented in the Table 6 (Panel B), negative coefficients of board independent variable across the three risk types support the positive effect of CEO power on firm risk, as found in the main findings and other tests. Nevertheless, the relationship*s* are found to be statistically insignificant.

Lastly, the study constructs an index for CEO power, which is the sum of three CEO-power dummy proxies: CEO pay slice (Cpower_D), CEO duality, and board independence

(See Section 4.f.ii for more detail). The findings of the model employing this index is shown in Table 6 (Panel C). It indicates that one unit increase in the CEO power index will lead to 1.4% increase in total risk, 1.5% increase in idiosyncratic risk and 0.01% increase in systematic risk. Overall, these findings confirm all the tests performed above, which support the Hypothesis 1 developed in Section 3.c.

Table 8: Robustness check using alternative independent variables

Table 8 presents the robustness check results using three alternative CEO power measures using clustered standard error at the firm level. These are CEO duality (Panel A), board independence (Panel B), and CEO power index (Panel C). CEO power index takes an ordinal value ranging from zero to three; it is the summation of three dummy variables proxied for CEO power, i.e., CEO duality dummy + CEO pay slice dummy + Board independence dummy (Section 4.f.ii). The dependent variables are total risk (TR), presented in columns 1-4 and 7; idiosyncratic risk (Risk_idio), presented in columns 2-5 and 8; and systematic risk (Risk_Sys), presented in columns 3-6 and 9. ***TR*** refers to the firm total risk measured by the natural logarithm of the standard deviation of the individual firm's daily stock returns yearly, ***Risk_Idio*** refers to the firm idiosyncratic risk measured by the natural logarithm of standard deviation of the residuals obtained from the single-index market model and, ***Risk_Sys*** refers to the market risk measured by the natural logarithm of the difference between TR and Risk_Idio. ***CEO_Age*** biological age of the CEO (in years). ***CEO_ female*** denotes one if the CEO is female and 0 otherwise. ***Delta is*** the natural logarithm of the change in dollar value of CEOs' wealth for a one percentage point change in stock price. ***CEO_Tenure*** is the natural logarithm of the number of years the CEO has held the position. ***CEO_Edu*** 1 if the CEO has a master's degree or above or 0 otherwise. ***Size*** refers to the logarithm of the firm total assets. ***Growth*** captures % annual growth rate in sales. ***Profit is*** the ratio of earnings before interest payments and income taxes to total assets. ***R&D%*** research and development expenses to total assets. ***Growth_oppo*** Market-to-book ratio. ***CAPEX*** captures % of net fixed assets to total assets. ***Div_cut*** dummy one if there is a reduction in annual dividend payout and 0 otherwise. ***Board_size*** is the number of directors on the firm board of directors. ***% Female*** the fraction of female directors on board. ***Financial and Covid crisis*** one if the firm-year observations fall in 2007-2009 and 2020-2021, respectively, and 0 otherwise. ***GDP_growth*** measures the countries' % GDP growth (economic growth), and Inflation_rate is the % annual change in the countries' consumer price index (CPI). ***Foreign_Inv*** measures the % of foreign direct investment in the countries' GDP, and ***Trade (% of GDP)*** measures the percentage of the countries' trade of their GDP. P-values in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% critical levels, respectively.

	Panel A: CEO duality			Panel B: Board independence			Panel C: CEO power index		
Variable	**(1) TR**	**(2) Risk_Idio**	**(3) Risk_Sys**	**(4) TR**	**(5) Risk_Idio**	**(6) Risk_Sys**	**(7) TR**	**(8) Risk_Idio**	**(9) Risk_Sys**
CEO_duality	.022***	.024***	.001*	-	-	-	-	-	-
	(.006)	(.003)	(.059)	-	-	-	-	-	-
Brd_indep	-	-	-	-.023	-.00006	-.027	-	-	-
	-	-	-	(.529)	(.966)	(.463)	-	-	-
CEO_power index	-	-	-	-	-	-	.014***	.015***	.001**
	-	-	-	-	-	-	(.003)	(.001)	(.03)
CEO_Age	-0.0002	-0.0003	-0.00007**	.00004	-.00004*	0.00008	0.00005	0.00008	-0.00005*
	(.617)	(.612)	(.014)	(.931)	(.062)	(.887)	(.925)	(.887)	(.063)
CEO_ female	-0.0003	-0.0004	0.0002	-.004	.0002	-.004	-.006	-.006	-0.00015
	(.974)	(.971)	(.731)	(.77)	(.735)	(.747)	(.619)	(.614)	(.794)
Delta	-.013***	-.012***	-.001***	-.012***	-.0004***	-.011***	-.013***	-.013***	-.001***
	(0.00)	(0.00)	(0.00)	(0.000)	(.002)	(0.000)	(0.00)	(0.00)	(0.00)
CEO_Tenure	-.01**	-.011**	-0.0003	-.01**	-.0004	-.011**	-.012**	-.012***	-0.0004
	(.025)	(.018)	(.15)	(.026)	(.109)	(.018)	(.011)	(.007)	(.112)
CEO_Edu	.01	.01	0.0002	.01	.0002	.01	.01	.01	0.0003
	(.161)	(.166)	(.397)	(.151)	(.421)	(.156)	(.163)	(.168)	(.342)
SIZE	-.043***	-.048***	-.002***	-.043***	-.002***	-.047***	-.042***	-.047***	-.002***
	(0.00)	(0.00)	(0.00)	(0.000)	(0.000)	(0.000)	(0.00)	(0.00)	(0.00)
Growth	-.014	-.015	0.0004	-.014	.0004	-.015	-.01	-.011	.001
	(.322)	(.303)	(.528)	(.304)	(.558)	(.284)	(.466)	(.441)	(.307)
Profit	-.166***	-.165***	-.008***	-.167***	-.008***	-.166***	-.165***	-.165***	-.008***

	(0.00)	(0.00)	(0.00)	(0.000)	(0.000)	(0.000)	(0.00)	(0.00)	(0.00)
R&D %	-.008	-.014	-.002	-.009	-.002	-.015	-.007	-.013	-.002
	(.903)	(.841)	(.524)	(.893)	(.514)	(.832)	(.919)	(.856)	(.464)
Growth_oppo	-0.0003	-0.0004	0.00003	-.0003	.00003	-.0004	-.001	-.001	0.00001
	(.406)	(.341)	(.215)	(.445)	(.23)	(.383)	(.137)	(.11)	(.663)
CAPEX	-.025	-.024	.002**	-.025	.002**	-.024	-.026	-.025	.002**
	(.285)	(.299)	(.011)	(.282)	(.01)	(.296)	(.268)	(.281)	(.018)
Leverage	.178***	.188***	.014***	.179***	.015***	.188***	.171***	.181***	.014***
	(0.00)	(0.00)	(0.00)	(0.000)	(0.000)	(0.000)	(.001)	(0.00)	(0.00)
Cash_surp	-.052	-.058	.001	-.054	.001	-.06*	-.052	-.057	.002
	(.135)	(.101)	(.514)	(.118)	(.551)	(.09)	(.143)	(.108)	(.289)
Div_cut	-.042***	-.045***	-.001***	-.042***	-.001***	-.045***	-.041***	-.045***	-.001***
	(0.00)	(0.00)	(.001)	(0.000)	(.001)	(0.000)	(0.00)	(0.00)	(.001)
Board_size	0.0004	.001	-0.00007	.0002	-.00008	.001	.001	.001	0.00004
	(.705)	(.547)	(.214)	(.83)	(.169)	(.683)	(.624)	(.481)	(.491)
% Female	-.125***	-.116**	-.003	-.115**	-.003	-.105**	-.116**	-.106**	-.003
	(.006)	(.011)	(.104)	(.012)	(.131)	(.022)	(.011)	(.02)	(.22)
Crisis_F	.239***	.212***	.008**	.241***	.008**	.215***	.244***	.217***	.007**
	(0.00)	(0.00)	(.015)	(0.000)	(.014)	(0.000)	(0.00)	(0.00)	(.016)
Crisis_C	.192***	.175***	.006*	.192***	.006*	.176***	.199***	.183***	.006*
	(0.00)	(.001)	(.076)	(0.000)	(.071)	(.001)	(0.00)	(.001)	(.063)
GDP_ Growth	.007	.006	0.0004	.007	.0004	.006	.007	.006	0.0005
	(.198)	(.312)	(.246)	(.202)	(.239)	(.318)	(.199)	(.314)	(.232)
Inflation_Rate	.02***	.021***	0.00004	.021***	.0004	.022***	.021***	.022***	0.00002
	(.005)	(.004)	(.462)	(.004)	(.446)	(.003)	(.005)	(.004)	(.972)
Foreign_ Inv	-0.0004	-.001	0.0001	0	.0001	-.001	-0.0004	-.001	0.00009
	(.828)	(.602)	(.198)	(.823)	(.206)	(.598)	(.808)	(.582)	(.46)
Trade (% of GDP)	.005***	.004**	-0.0005	.005***	-.00004	.005***	.005***	.005***	-0.00004**
	(.007)	(.015)	(.548)	(.003)	(.584)	(.007)	(.004)	(.009)	(.035)
Constant	-1.519***	-1.402***	-2.245***	-1.56***	-2.247***	-1.448***	-1.594***	-1.483***	-2.262***
	(0.00)	(0.00)	(0.00)	(0.000)	(0.000)	(0.000)	(0.00)	(0.00)	(0.00)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12910	12759	12759	12836	12685	12685	12836	12685	12685
R-squared	0.250	0.261	0.193	0.251	0.262	0.189	0.251	0.262	0.189
F-statistic	33.220	27.022	24.599	33.019	26.750	25.963	33.019	26.750	25.963

c. *CEO power and firm risk in financial and health crises*

i. *Difference in difference approach (DiD)*

To provide further insight into the relationship between CEO power and firm risk, the current study also investigates whether such a relationship holds or differs during turbulences, such as the financial crisis of 2007 and the health crisis of COVID-19 2020 (Hypothesis 2). The difference in difference (DiD) approach is employed for all three risk measures: total risk, idiosyncratic risk, and systematic risk, as explained in Section 4. g.i. The results are shown in Table 9. Looking at the coefficients of the two crisis dummies (Crisis_C and Crisis_F, for the covid crisis and financial crisis, respectively), the positive and statistically significant coefficients indicate that firm risk tends to be higher during both financial and health crises by approximately 10-13% for total risk and idiosyncratic risk (column 1-2). This is understandable because corporations are exposed to greater uncertainty during turbulent times, hence their stock price fluctuation, i.e., firm risk. Based on the economic significance of these two variables, the two indications they provide are (1) the risk levels of firms are different (particularly higher) in crisis compared to non-crisis, and (2) the differences in firm risk between crisis and non-crisis are relatively the same for financial and health crisis.

Nevertheless, a different interpretation of whether crises influence the relationship between CEO power and firm risk is obtained. First, the Cpower_D yields consistent positive coefficients for all three risks. This indicates that firms run by powerful CEOs are exposed to 2.5% higher risk than those run by non-powerful CEOs (for total risk and idiosyncratic risk). This confirms the impact of CEO power on firm risk, which the study has obtained thus far using different analyses (See Section 5. b). The interaction terms between the COVID crisis and CEO power and financial crisis and CEO power are statistically insignificant. This implies that financial and health crises do not influence the CEO power–risk relationship statistically significantly. In other words, firms run by powerful CEOs remain exposed to 2.4% higher risk than those run by non-powerful CEOs, regardless of whether the firms operate in crisis or non-crisis periods (health and financial crises). The findings show that if CEOs have tremendous power and control over the firms, they are likely to exercise it in the same way, and perhaps their views and characteristics towards risk-related decisions also remain the same (i.e., optimistic and overlook uncertainty) during regular operating periods as well as turbulent periods. Consequently, the markets' economic, financial, or health conditions would not influence the relationship between CEO power and firm risk.

Table 9: CEO power and firm risk across financial and health crises – Difference in Difference (DiD)

Table 9 presents the results of the relationships between CEO power and firm risk during the financial and COVID crises, compared to non-crisis periods, using the difference in difference (DiD) approach. ***TR*** refers to the firm total risk measured by the natural logarithm of the standard deviation of the individual firm's daily stock returns yearly, ***Risk_Idio*** refers to the firm idiosyncratic risk measured by the natural logarithm of standard deviation of the residuals obtained from the single-index market model and, ***Risk_Sys*** refers to the market risk measured by the natural logarithm of the difference between TR and Risk_Idio. **Cpower_D** is a dummy variable denoting unity if the CEO pay slide (CPS) is greater than the median value of the sample and zero otherwise. **Crisis_C and Crisis_F** capture Financial and Covid crises equal to 1 if the firm-year observations fall in 2007-2009 and 2020-2021, respectively, and 0 otherwise. ***CEO_Age*** biological age of the CEO (in years). **Cpower_covid** is the term for the interaction between Cpower_D and Crisis_C. **Cpower_crisis** is the term for the interaction between Cpower_D and Crisis_F. ***CEO_ female*** denotes one if the CEO is female and 0 otherwise. ***Delta is*** the natural logarithm of the change in dollar value of CEOs' wealth for a one percentage point change in stock price. ***CEO_Tenure*** is the natural logarithm of the number of years the CEO has held the position. ***CEO_Edu*** 1 if the CEO has a master's degree or above or 0 otherwise. ***Size*** refers to the logarithm of the firm total assets. ***Growth*** captures % annual growth rate in sales. ***Profit is*** the ratio of earnings before interest payments and income taxes to total assets. ***R&D%*** research and development expenses to total assets. ***Growth_oppo*** Market-to-book ratio. ***CAPEX*** captures % of net fixed assets to total assets. ***Div_cut*** dummy one if there is a reduction in annual dividend payout and 0 otherwise. ***Board_size*** is the number of directors on the firm board of directors. ***% Female*** the fraction of female directors on board. ***GDP_growth*** measures the countries' % GDP growth (economic growth), and Inflation_rate is the % annual change in the countries' consumer price index (CPI). ***Foreign_Inv*** measures the % of foreign direct investment in the countries' GDP, and ***Trade (% of GDP)*** measures the percentage of the countries' trade of their GDP. P-values in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% critical levels, respectively.

Variable	TR	Risk_Idio	Risk_Sys
Cpower_D	.024***	.023***	.002***
	(.007)	(.009)	(0.000)
cpower_covid	-.018	-.016	-.001
	(.468)	(.525)	(.787)
Crisis_C	.119**	.125**	-.009
	(.039)	(.034)	(.107)
cpower_crisis	.018	.016	.002
	(.222)	(.29)	(.186)
Crisis_F	.13***	.127***	.008*
	(.006)	(008)	(.083)
CEO_Age	0.0002	0.0002	0.00004
	(.658)	(.627)	(.253)
CEO_ female	-.015	-.014	-.001
	(.217)	(.253)	(.67)
Delta	-.008***	-.008***	-0.0004**
	(.001)	(.002)	(.048)
CEO_Tenure	-.012***	-.013***	-0.00005
	(.009)	(.006)	(.896)
CEO_Edu	.012*	.012*	0.0002
	(.091)	(.094)	(.71)
SIZE	-.042***	-.047***	.005***
	(0.000)	(0.000)	(0.000)
Growth	-.038*	-.04*	.001
	(.083)	(.073)	(.332)
Profit	-.169***	-.168***	-.003***
	(0.000)	(0.00)	(.005)
R&D %	-.011	-.017	.003
	(.876)	(.805)	(.157)
Growth_oppo	-.001*	-.001*	0.00005
	(.066)	(.054)	(.145)
CAPEX	-.025	-.024	-.001*
	(.286)	(.299)	(.053)
Leverage	.172***	.181***	-.005
	(.001)	(0.000)	(.12)
Cash_surp	-.036	-.043	.005***
	(.302)	(.226)	(.003)
Div_cut	-.045***	-.048***	.003***

	(0.000)	(0.000)	(0.000)
Board_size	.003**	.003**	0.00004
	(.02)	(.016)	(.745)
% Female	-.104**	-.097**	-.006*
	(.02)	(.032)	(.052)
GDP_ Growth	-0.0004	.001	-.001**
	(.944)	(.911)	(.019)
Inflation_Rate	.003	.008	-.004***
	(.628)	(.261)	(0.000)
Foreign_ Inv	-.002	-.003	.001***
	(.216)	(.103)	(0.000)
Trade (% of GDP)	-0.0003	-0.0004	0.0001***
	(.316)	(.134)	(.002)
Constant	-1.503***	-1.43***	-2.377***
		(0.000)	(0.000)
Year fixed effect	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Country fixed effect	No	No	No
Observations	12836	12685	12685
R-squared	0.244	0.256	0.451
F-statistic	30.730	24.389	53.377

ii. Subsample approach

Examining the same matter, this section reveals results using a different method, presented in Table 10. Particularly, instead of conducting a DiD regression on the full sample, simple OLS models with clustered standard error at the firm level (see Section 4.e, eq.3) are performed on four sub-samples: financial crisis, non-financial crisis, covid, and non-covid samples. By performing on crisis and non-crisis subsamples, four coefficients of CEO power (CPS) in each subsample will be obtained. Subsequently, Chow's test will examine whether those CEO power coefficients are statistically different across different subsamples.

Regarding the CEO power-risk relationship between the financial crisis and non-financial crisis, two CPS's coefficients, i.e., 0.132 and 0.085 (p-value < 0.1 and 0.05, respectively), indicate that during the financial crisis periods, every 1% increase in CEO power leads to 13.2% increase in firm total risk. However, during the non-financial crisis period, such impact is 8.5%. This is to say, the positive impact of CEO power on firm risk remains relatively similar across both financial and non-financial crises. This finding is consistent with the DiD approach.

However, findings for the health crisis show that CEOs only exercise their power to increase firm risk during the non-covid times ($\beta_{CPS} = 0.101$, p-value <0.01, Table 10, column 4). However, during the pandemic, CEO power has lost its influence on firm risk ($\beta_{CPS} = 0.015$, insignificant, Table 8, column 3). According to Chow's test, the relationship between CEO power and firm risk during COVID and non-COVID periods is statistically significantly different.

Overall, using the subsampling method, hypothesis 2 is supported such that crises negatively moderate the positive effects of CEO power on firm risk. However, the effects differ between the financial crisis of 2007 and the health crisis of 2020. Particularly, CEO power loses its effects on firm risk during the COVID crisis but remains unchanged during financial and non-financial crises. As explained previously (in Sections 3.c and 5.b), CEOs with more power tend to be more optimistic and underestimate the uncertainty involved with their risk decisions, leading to riskier decisions and higher risk outcomes. Nevertheless, it is sensible that during turbulences, CEOs should be much more cautious with their risk decision-making due to all the uncertainty surrounding the crises. As a result, CEOs with more power should be more cautious and conservative in their risk-related decision-making during crises. Nevertheless, the moderating effects are only recorded for the COVID crisis but not the financial crisis.

The inconclusive findings between the two methods (DID OLS and subsample OLS) are partially due to the differences in the analytical methods and the measures employed. Particularly, for the DiD, the CEO pay slice (CPS) is converted into a dummy, whilst the sub-sample methods employ the original CPS. Therefore, additional checks will be performed to clarify the findings and to draw a conclusion on the subject matter. Specifically, with the same employment of the dummy CEO power, we employed the DiD with propensity score matching (PSM) to retest for both Hypothesis 1 and Hypothesis 2.

Table 10: CEO power and firm risk across financial and health crises – Sub-sample regressions

Table 10 presents the results of the relationships between CEO power and firm risk during the financial and COVID crises, using sub-samples of financial crisis, non-financial crisis, COVID and non-covid periods (together with Chow's test). The dependent variable employed is ***TR***, which refers to the firm's total risk measured by the natural logarithm of the standard deviation of an individual firm's daily stock returns yearly. **CPS** captures the percentage of the CEO's total compensation to the total compensation of the top five executives in each firm. ***CEO_Age*** biological age of the CEO (in years). ***CEO_ female*** denotes one if the CEO is female and 0 otherwise. ***Delta is*** the natural logarithm of the change in dollar value of CEOs' wealth for a one percentage point change in stock price. ***CEO_Tenure*** is the natural logarithm of the number of years the CEO has held the position. ***CEO_Edu*** 1 if the CEO has a master's degree or above or 0 otherwise. ***Size*** refers to the logarithm of the firm total assets. ***Growth*** captures % annual growth rate in sales. ***Profit is*** the ratio of earnings before interest payments and income taxes to total assets. ***R&D%*** research and development expenses to total assets. ***Growth_oppo*** Market-to-book ratio. ***CAPEX*** captures % of net fixed assets to total assets. ***Div_cut*** dummy one if there is a reduction in annual dividend payout and 0 otherwise. ***Board_size*** is the number of directors on the firm board of directors. ***% Female*** the fraction of female directors on board. ***Financial and Covid crisis*** one if the firm-year observations fall in 2007-2009 and 2020-2021, respectively, and 0 otherwise. ***GDP_growth*** measures the countries' % GDP growth (economic growth), and Inflation_rate is the % annual change in the countries' consumer price index (CPI). ***Foreign_Inv*** measures the % of foreign direct investment in the countries' GDP, and ***Trade (% of GDP)*** measures the percentage of the countries' trade of their GDP. P-values in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% critical levels, respectively.

	Financial Crisis Vs Non-financial Crisis		Covid and non-covid crisis	
Variable	**(1) Financial Crisis**	**(2) Non-financial crisis**	**(3) Covid**	**(4) Non-covid**
CPS	.132*	.085**	.015	.101***
	(.069)	(.023)	(.889)	(.003)
CEO_Age	-.001	.001	.001	0.0003
	(.437)	(.263)	(.534)	(.606)
CEO_ female	-.07***	.001	-.024	-.004
	(.009)	(.93)	(.366)	(.769)
Delta	-.012***	-.013***	-.023***	-.012***
	(.009)	(0.000)	(.001)	(0.000)
CEO_Tenure	-.012	-.012**	-.01	-.012***
	(.202)	(.019)	(.587)	(.008)
CEO_Edu	.018	.008	.032	.007
	(.233)	(.306)	(.163)	(.322)
SIZE	-.037***	-.044***	-.054***	-.042***
	(0.000)	(0.000)	(0.000)	(0.000)
Growth	-.024	-.005	-.006	-.009
	(.306)	(.768)	(.91)	(.549)
Profit	-.132***	-.177***	-.121	-.166***
	(.003)	(0.000)	(.139)	(0.000)
R&D %	-.2**	.059	.416*	-.035
	(.037)	(.465)	(.051)	(.637)
Growth_oppo	-.002	-0.0002	-.002**	-.001
	(.143)	(.542)	(.029)	(.289)
CAPEX	-.053	-.018	-.038	-.026
	(.108)	(.505)	(.628)	(.208)
Leverage	.186**	.156***	.383***	.151***
	(.018)	(.005)	(.006)	(.003)
Cash_surp	-.015	-.065*	.005	-.055
	(.777)	(.076)	(.954)	(.125)
Div_cut	-.056***	-.039***	-.088***	-.036***
	(.001)	(0.000)	(.001)	(0.000)
Board_size	.001	.001	.003	.001
	(.746)	(.494)	(.428)	(.692)
% Female	-.071	-.117**	-.079	-.113**
	(.334)	(.015)	(.54)	(.011)
Crisis_C	0	.221***	-	-
	.	(.001)	-	-
Crisis_F	-	-	0	.189***
	-	-	.	(0.000)
GDP_ Growth	-.012	.008	.011	-.005
	(.397)	(.276)	(.887)	(.497)
Inflation_Rate	.037	.018*	-.004	.032***
	(.178)	(.082)	(.957)	(0.000)
Foreign_ Inv	-.004	.001	.015	-0.0004
	(.734)	(.745)	(.904)	(.831)
Trade (% of GDP)	.006	.006***	-.001	.005***

	(.601)	(.007)	(.819)	(.004)
Constant	-1.543*	-1.685***	-1.064***	-1.595***
	(.081)	(0.000)	(0.000)	(0.000)
Year fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
country fixed effect	Yes	Yes	Yes	Yes
Observations	2671	10165	967	11869
R-squared	0.215	0.261	0.292	0.245
F-statistic	38.798	26.612	6.321	22.587
Chow test	F (2, 1540) = 13.42***		F (2, 1540) = 7.51***	

iii. Difference in difference (DiD) with Propensity score matching (PSM)

In this section, we employ the propensity score matching (PSM) approach to re-examine the influences of CEO power on firm risk. The employment of PSM tackles the issue of sample selection bias. In more detail, according to the logistic test with the CEO power dummy as the dependent variable, the powerful CEO sample tends to be younger, female, and with lower tenure, employed by smaller firms, to mention a few. This is to say, the powerful CEO sample possesses distinct characteristics that may contribute to the higher firm risk instead of the CEO power effect per se. Furthermore, we also conduct the same model on different sub-samples: financial crisis, non-financial crisis, COVID, and non-COVID crisis, based on which differences in difference statistics are computed to examine the differences in CEOpower-risk relationship across different turbulences. The results are presented in Table 11.

Firstly, we tested for the 'balancing property' of the match using the B estimate and Rubin's R (Rosenbaum & Rubin, 1985). The results indicate that the matching is successful and effective with a B estimate lower than 25%, and Rubin's R lies between 0.5 and 2 (B=18.5; R=0.84). In Panel A, the result indicates that after matching powerful CEOs with non-powerful CEOs of the same characteristics (i.e., matching by propensity score), the average firm risk of the powerful CEO sample is significantly higher than that of the matched non-powerful CEO sample (Δ = 0.0248, p-value < 0.01). This confirms the main findings from the baseline OLS estimation and various robustness checks (Section 5.b). Once again, the PSM result supports Hypothesis 1: firms led by powerful CEOs exhibit higher risk than those led by non-powerful CEOs.

Re-examining Hypothesis 2 on the moderating effect of CEO power on firms, we use the DID approach with PSM, a robust methodology for our research. The results for the financial and COVID crises are shown in Panel B and Panel C, respectively. For financial crisis, firms led by powerful CEOs are associated with higher risk for both crisis and non-crisis periods (**Δ** = 0.0396 & 0.0247, p-value < 0.05). Using the DID method, the difference in CEO power effect between crisis and non-crisis is statistically insignificant (Δcrisis – Δnon-crisis = 0.01494, ns). This shows that the effect of CEO power on risk remains unchanged for both crisis periods, which is consistent with the DID OLS and subsample OLS models. Regarding the COVID health crisis (Table 11, Panel C), consistent with the sub-sample approach (Section 5.c.ii), CEO power only increases firm risk during the non-covid crisis and carries no significant effect on firm risk during the COVID crisis (Δ_{covid} = 0.0184, ns; $\Delta_{non\text{-}covid}$ = 0.0293, p-value <0.01). Computing the DID t-statistic, the difference in CEO power effect between health crisis and non-health crisis is statistically significant at a 1% level ($\Delta_{covid} - \Delta_{non\text{-}covid}$ = -0.0109, p-value < 0.01).

Overall, after several tests on the moderating effects of crises, separating financial and health crises, it is concluded that crises tend to mitigate the effects of CEO power on firm risk. This has significant implications for understanding CEO behaviour during turbulent times. As explained in previous sections, during turbulences, CEOs are less optimistic and confident about market conditions due to the extensive level of uncertainty. Hence, they are more cautious and reluctant to exercise their power to increase firm risk. This supports our second hypothesis and opens up new avenues for research in crisis management and CEO decision-making.

However, that phenomenon only occurred during the COVID-19 health crisis, which may be because of the nature of the crisis, which is too sudden, unexpected and unfamiliar to corporations and economies. The executives face challenges predicting future uncertainties without much reference and experience dealing with such health crises. This would put upward pressure on CEOs in strategic decision-making and, hence, cause them to be reluctant to commit to higher risk. For financial crisis, although the consequences of the crisis are prominent and contagious, the financial nature of the crisis is not a new concept. In many cases, it is not unpredictable. Therefore, powerful CEOs' optimism and confidence remain.

Table 9: Propensity score matching (PSM) on the CEO power and risk – Moderating effects of crises

*Table 9 presents the PSM results of the average treatment effects (ATE) and the average treatment effect on the treated ( ) with 1:1 matching. h e and of power on the firm risk (Δ) are estimated by the difference between the mean changes of firms with powerful s (column " reated") and that of matched firms with non-powerful CEOs (column " on-treated"). -statistics with robust standard errors in the final column. *** p<0.01, ** p<0.05, * p<0.1.*

			Treated	Control	Δ	S.E.	T-stat
Panel A: PSM on CEO power and firm risk							
Full sample	***TR***	Unmatched	-2.0445	-2.0074	-0.0371***	0.0058	-6.29
		Matched - ATT	-2.0444	-2.0693	0.0248***	0.0090	2.75
Panel B: Difference in Difference with PSM: financial and non-financial crisis							
Financial Crisis	***TR***	Unmatched	-1.9790	-1.9592	-0.0199	0.0141	-1.41
		Matched - ATT	-1.9792	-2.0188	0.0396**	0.0195	2.03
Non-financial Crisis	***TR***	Unmatched	-2.0558	-2.0144	-0.0414***	0.0069	-5.99
		Matched - ATT	-2.0558	-2.0806	0.0247**	0.0102	2.42
		Δ – Δ -crisis)			0.01494		0.65
Panel C: Difference in Difference with PSM: COVID and non-COVID crisis							
Covid Crisis	***TR***	Unmatched	-1.9519	-1.8993	-0.0527**	0.0267	-1.97
		Matched - ATT	-1.9519	-1.9704	0.01840	0.0378	0.49
Non-Covid Crisis	***TR***	Unmatched	-2.0459	-2.0130	-0.0329***	0.0064	-5.17
		Matched - ATT	-2.0459	-2.0752	0.0293***	0.0091	3.21
		Δ – Δ -crisis)			-0.0109		2.803***

iv. Additional analysis: CEO power on firm risk across non-financial and financial firms

Table 12 illustrates the differences in the effect of CEO power and firm risk across non-financial firms (Panel A) and financial firms (Panel B). The results indicate that the relationship between CEO power and firm risk is statistically significant and positive only in non-financial firms. In other words, the findings obtained thus far are driven mainly by the non-financial firms. After excluding financial firms, the obtained coefficients are much greater than those previously obtained. It indicates that a 1% increase in CEO power causes a 9.6% increase in total risk, a 9.4% increase in idiosyncratic risk, and a 0.7 % increase in systematic risk. The reason may be that financial firms are followed strictly by analysts and exposed to many regulations and guidelines. Even with power, CEOs of those firms must be careful in their decision-making because their behaviours and firms' performances are monitored and overseen closely by market participants (Elyasiani & Zhang, 2015). Therefore, it is challenging for CEOs to utilise their power to increase their firms' risk.

Table 12: Influences of CEO power on firm risk – Non-Financial and Financial

Table 12 presents the results of the CEO power-risk relationship across non-financial (Panel A) and financial (Panel B) firms using OLS with cluster standard error at the firm level. ***TR*** refers to the firm total risk measured by the natural logarithm of the standard deviation of the individual firm's daily stock returns yearly, ***Risk_Idio*** refers to the firm idiosyncratic risk measured by the natural logarithm of standard deviation of the residuals obtained from the single-index market model and, ***Risk_Sys*** refers to the market risk measured by the natural logarithm of the difference between TR and Risk_Idio. **CPS** captures the percentage of the CEO's total compensation to the total compensation of the top five executives in each firm. ***CEO_Age*** biological age of the CEO (in years). ***CEO_ female*** denotes one if the CEO is female and 0 otherwise. ***Delta is*** the natural logarithm of the change in dollar value of CEOs' wealth for a one percentage point change in stock price. ***CEO_Tenure*** is the natural logarithm of the number of years the CEO has held the position. ***CEO_Edu*** 1 if the CEO has a master's degree or above or 0 otherwise. ***Size*** refers to the logarithm of the firm total assets. ***Growth*** captures % annual growth rate in sales. ***Profit is*** the ratio of earnings before interest payments and income taxes to total assets. ***R&D%*** research and development expenses to total assets. ***Growth_oppo*** Market-to-book ratio. ***CAPEX*** captures % of net fixed assets to total assets. ***Div_cut*** dummy one if there is a reduction in annual dividend payout and 0 otherwise. ***Board_size*** is the number of directors on the firm board of directors. ***% Female*** the fraction of female directors on board. ***Financial and Covid crisis*** one if the firm-year observations fall in 2007-2009 and 2020-2021, respectively, and 0 otherwise. ***GDP_growth*** measures the countries' % GDP growth (economic growth), and Inflation_rate is the % annual change in the countries' consumer price index (CPI). ***Foreign_Inv*** measures the % of foreign direct investment in the countries' GDP, and ***Trade (% of GDP)*** measures the percentage of the countries' trade of their GDP. P-values in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% critical levels, respectively.

	Panel A: Non-financial firms			Panel B: Financial firms		
Variable	**(1) TR**	**(2) Risk_Idio**	**(3) Risk_Sys**	**(4) TR**	**(5) Risk_Idio**	**(6) Risk_Sys**
CPS	.096***	.094***	.007***	-.078	-.084	.009
	(.007)	(.009)	(.004)	(.305)	(.271)	(.219)
CEO_Age	0.004	0.0004	0.0005	-0.0001	0.0003	-0.0002**
	(.484)	(.47)	(.178)	(.877)	(.978)	(.014)
CEO_ female	-.008	-.008	0.0001	.03	.026	.006***
	(.526)	(.536)	(.935)	(.326)	(.401)	(.009)
Delta	-.013***	-.013***	-.001***	.007	.007	-0.0002
	(0.000)	(0.000)	(.002)	(.286)	(.265)	(.698)
CEO_Tenure	-.012**	-.013***	0.00001	-.019**	-.017*	-.003***
	(.011)	(.007)	(.963)	(.029)	(.05)	(.007)
CEO_Edu	.012	.012	0.0001	-.03**	-.033**	.002*
	(.113)	(.116)	(.814)	(.041)	(.028)	(.092)
SIZE	-.045***	-.049***	.004***	-.024***	-.028***	.004***
	(0.000)	(0.000)	(0.000)	(.004)	(.001)	(0.000)
Growth	-.009	-.01	0.0004	-.047	-.043	-.007
	(.522)	(.492)	(.361)	(.573)	(.609)	(.249)
Profit	-.154***	-.153***	-.002**	-.498**	-.502**	-0.0004
	(0.000)	(0)	(.048)	(.022)	(.021)	(.927)
R&D %	-.01	-.015	.003	.262	.221	.051
	(.887)	(.824)	(.256)	(.224)	(.316)	(.109)
Growth_oppo	-.001	-.001	0.00004	0.00005	-0.0001	0.0002***
	(.12)	(.104)	(.222)	(.925)	(.739)	(.008)
CAPEX	-.03	-.03	-.002**	-.027	-.027	0.0001
	(.224)	(.236)	(.034)	(.188)	(.194)	(.919)
Leverage	.169***	.181***	-.008**	.026	-.001	.038***
	(.001)	(.001)	(.019)	(.837)	(.994)	(0.000)
Cash_surp	-.054	-.06*	.004**	-.018	-.013	-0.00009
	(.132)	(.099)	(.017)	(.867)	(.899)	(.991)
Div_cut	-.046***	-.049***	.003***	.016	.016	.001
	(0.000)	(0.000)	(0.000)	(.511)	(.526)	(.536)
Board_size	.001	.001	-0.0001	.001	.001	-0.0003
	(.444)	(.329)	(.458)	(.676)	(.544)	(.287)
% Female	-.118**	-.107**	-.01***	-.057	-.057	.003
	(.013)	(.025)	(.004)	(.555)	(.561)	(.699)
Crisis_F	.246***	.221***	.032***	.251***	.194**	.059***
	(0.000)	(0.000)	(0.000)	(.004)	(.029)	(0.000)
Crisis_C	.195***	.178***	.016***	.222**	.188*	.032**
	(.001)	(.002)	(0.000)	(.025)	(.064)	(.019)
GDP_ Growth	.007	.006	.001***	.017	.012	.005***
	(.237)	(.344)	(.002)	(.128)	(.3)	(.003)
Inflation_Rate	.021***	.022***	-.001	.032*	.031*	-.001
	(.006)	(.004)	(.331)	(.077)	(.093)	(.759)
Foreign_ Inv	-.001	-.001	.001***	.004	.003	.001**

	(.754)	(.536)	(0.000)	(.544)	(.63)	(.013)
Trade (% of GDP)	.005***	.005**	.001***	.002	.001	.001***
	(.006)	(.012)	(0.000)	(.601)	(.771)	(.001)
Constant	-1.565***	-1.448***	-2.43***	-1.824***	-1.72***	-2.428***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12144	11993	11993	692	692	692
R-squared	0.252	0.460	0.263	0.307	0.288	0.626
F-statistic	31.339	55.717	25.422	10.939	7.482	22.291

v. Additional analysis: CEO power and firm risk across firms with different growth opportunities and R&D Expenses

Lastly, we extend the analysis to examine the effects of CEO power on firm risk across different levels of the firm's current R&D expense and growth opportunity. Table 13 illustrates the results for high (low) growth firms (Panel A) and high (low) R&D firms (Panel B). The results show that CEO power's positive effects on firm risk remain unchanged across high-growth and low-growth firms (β_{CPS} = 0.064 and 0.133, p-value <0.05, respectively). Nevertheless, the effect is weakened for high-growth firms, i.e., lower economic significance. In other words, CEOs exercise their power to increase firm risk more strongly if the firms possess low growth opportunities. This may be because higher risk is often associated with higher returns, and hence, CEOs with power are more confident and optimistic that they can increase the growth rate of low-growth firms by taking on higher risk.

In terms of R&D expense, the positive relationship between CEO power and firm risk is mainly driven by firms with low R&D expenses. The reason lies in firms' risk-taking capacity, which is linked to their R&D expenditure (Yung & Chen, 2018). Firms with low R&D expenses signify a lower risk level (high risk-taking capacity) than firms with high R&D spending. Therefore, with a greater risk capacity, powerful CEOs can be more confident in employing their power to increase firm risk for higher firm performance.

Table 13: CEO power-risk relationship across firms with different growth opportunities and research and development expenditure

Table 13 presents the results of the relationships between CEO power and firm risk across firms with high growth and low growth and firms with high R&D expenditure and low R&D expenditure using OLS with cluster standard error at the firm level. The dependent variable employed is ***TR, which refers to the firm's total risk measured by the natural logarithm of the standard deviation of an*** individual firm's daily stock returns yearly. **CPS** captures the percentage of the CEO's total compensation to the total compensation of the top five executives in each firm. ***CEO_Age*** biological age of the CEO (in years). ***CEO_ female*** denotes one if the CEO is female and 0 otherwise. ***Delta is*** the natural logarithm of the change in dollar value of CEOs' wealth for a one percentage point change in stock price. ***CEO_Tenure*** is the natural logarithm of the number of years the CEO has held the position. ***CEO_Edu*** 1 if the CEO has a master's degree or above or 0 otherwise. ***Size*** refers to the logarithm of the firm total assets. ***Growth*** captures % annual growth rate in sales. ***Profit is*** the ratio of earnings before interest payments and income taxes to total assets. ***R&D%*** research and development expenses to total assets. ***Growth_oppo*** Market-to-book ratio. ***CAPEX*** captures % of net fixed assets to total assets. ***Div_cut*** dummy one if there is a reduction in annual dividend payout and 0 otherwise. ***Board_size*** is the number of directors on the firm board of directors. ***% Female*** the fraction of female directors on board. ***Financial and Covid crisis*** one if the firm-year observations fall in 2007-2009 and 2020-2021, respectively, and 0 otherwise. ***GDP_growth*** measures the countries' % GDP growth (economic growth), and Inflation_rate is the % annual change in the countries' consumer price index (CPI). ***Foreign_Inv*** measures the % of foreign direct investment in the countries' GDP, and ***Trade (% of GDP)*** measures the percentage of the countries' trade in their GDP. P-values in parentheses. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% critical levels, respectively.

Panel A: Growth Opportunity and Panel B: R&D Expenditure

Variable	(1) High Growth	(2) Low Growth	(3) High R&D	(4) Low R&D
CPS	.064**	.133**	.089	.089**
	(.042)	(.02)	(.14)	(.028)
CEO_Age	0.0003	.001	0	.001
	(.54)	(.464)	(.804)	(.397)
CEO_ female	.006	-.018	-.02	-.001
	(.596)	(.46)	(.451)	(.909)
Delta	-.007***	-.021***	-.015***	-.01***
	(.003)	(0.000)	(.002)	(0.000)
CEO_Tenure	-.007	-.027***	-.014	-.011***
	(.104)	(.003)	(.121)	(.01)
CEO_Edu	.005	.021	.003	.012*
	(.423)	(.136)	(.836)	(.094)
SIZE	-.04***	-.049***	-.05***	-.034***
	(0.000)	(0.000)	(0)	(0.000)
Growth	-.004	-.005	-.005	-.02
	(.787)	(.806)	(.808)	(.31)
Profit	-.19***	-.137***	-.133***	-.211***
	(0.000)	(0.000)	(.001)	(0)
R&D %	-.077	.058	-.077	-1.574***
	(.313)	(.495)	(.339)	(.001)
Growth_oppo	-.001	.002	-.001	-.001
	(.306)	(.119)	(.19)	(.23)
CAPEX	-.062	-.015	-.026	-.023
	(.117)	(.459)	(.396)	(.296)
Leverage	.071	.201**	.286**	.142***
	(.189)	(.001)	(.024)	(.001)
Cash_surp	-.014	-.093**	-.125**	.016
	(.704)	(.048)	(.012)	(.734)
Div_cut	-.028***	-.063***	-.093***	-.019**
	(0.000)	(0.000)	(0)	(.012)
Board_size	.001	.001	-.001	.001
	(.463)	(.554)	(.704)	(.253)
% Female	-.06	-.19***	-.068	-.134***
	(.157)	(.003)	(.491)	(0.000)
Crisis_C	.169***	.35***	.187	.265***
	(0.000)	(.004)	(.112)	(0.000)
Crisis_F	.184***	.274*	.159	.21***
	(0.000)	(.053)	(.217)	(0.000)
GDP_ Growth	.007	.013	-.004	.013**
	(.155)	(.408)	(.764)	(.012)
Inflation_Rate	.015**	.029	.019	.021***
	(.016)	(.191)	(.306)	(.006)
Foreign_ Inv	.001	-.002	.005	-.003
	(.571)	(.648)	(.28)	(.169)

Trade (% of GDP)	.006***	.001	.011***	.002
	(.001)	(.656)	(.004)	(.199)
Constant	-1.837***	-1.232***	-1.719***	-1.627***
	(0.000)	(0.000)	(0.000)	(0.000)
Year fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
country fixed effect	Yes	Yes	Yes	Yes
Observations	12836	8689	12836	4984
R-squared	0.251	0.265	0.251	0.262
F-statistic	32.699	21.885	32.699	19.189

6. DISCUSSION AND CONCLUSIONS

This paper investigates the influence of CEO power on firm risk in an international context during the 2007 global financial crisis and the COVID-19 crisis. The study combined agency theory with the behavioural agency model and inhibition/approach theory to explain the relationship between CEO power and firm risk using G7-listed firms. Cross-country panel data of 12,836 firm-year observations from 2006 to 2021 are employed. The study provides empirical evidence of a significant positive relationship between CEO power and three types of firm risk: total risk, idiosyncratic risk, and systematic risk. The economic significance is more pronounced for total risk and idiosyncratic risk, indicating that CEO power's positive influence on firm risk is mainly driven by firm-specific risk. The data were obtained from multiple sources: DataStream, BoardEx, the World Bank, and the International Monetary Fund. Lewellyn and Muller-Kahle (2012) recommended further research into the power of CEOs by developing a measure of possible sources of their compensation and power. Accordingly, this study adopts CEO compensation (CPS) and confirms the results of Lewellyn and Muller-Kahle (2012) and Sheikh (2019).

Our findings confirm these two studies conducted on firm samples, concluding that CEO power significantly correlates positively with firm risk. Extending their conclusions, this study also finds that the relationship between CEO power and risk is stronger in non-crisis periods. This suggests that power may allow and incline CEOs to take more risks in times of financial stability and discourage them (or at least encourage caution) from taking risks during crises. This argument complements the premise of the behavioural agency model and inhibition/approach theory that CEOs' risk-taking behaviour increases with power due to their propensity to be optimistic in their perceptions of risk (Anderson & Galinsky, 2006). A distinction is made between the global financial crisis 2007 and the COVID-19 crisis 2020. Particularly, the increased risk with CEO power remains relatively unchanged across financial and non-financial crises. However, such an effect only remains during non-COVID crises and disappears during COVID crises. This may be because the optimism and confidence of powerful CEOs are reduced during turbulence that they are unfamiliar with and have no reference to or experience of, which was the COVID case. Possibly, CEOs with power are more reluctant to increase firm risk during new or 'strange' occurrences like a pandemic. It is possible that, if there is a similar public health crisis in the future, the relationship between CEO power and firm risk will be detected since the health crisis will then become a familiar phenomenon that they have experienced.

The findings of this study offer international empirical evidence for the relationship between CEO power and firms' risk-taking, which has several implications in practice, particularly for firms, current and potential investors, and regulators or policymakers. For example, policymakers can use our evidence as a proactive tool to anticipate the impact of crises on investors and markets by analysing how CEO power affects corporate risk. Regulators may also establish improved rules and regulations to minimise risk and prevent future turbulence. Based on the recommendations, firms and investors can use our findings to gain deeper insights into managing risks associated with powerful CEOs. This study can help enhance senior managers' hiring criteria and understand the risks associated with powerful CEOs during crises. Furthermore, as shown in this study, power helps to reduce extremely conservative attitudes in the risk-taking of CEOs. Such risk-aversion appears to be detrimental to shareholder's wealth accumulation. As the key findings of this study demonstrate, CEO power is more likely to cause firm risk to increase, in line with those of Finkelstein and Hambrick (1996) and Lewellyn and Kahle (2012). In this respect, the board of directors and top management are encouraged to delegate more power to CEOs to achieve positive outcomes and meet firms' objectives. CEO power is expected to work effectively and achieve a reasonable return on investment. However, they should reduce authoritarian CEOs' power and adopt strict corporate governance to obtain firms' potential and restrict CEOs' risk-based compensation. At the same time, the demonstrated positive relationship between CEO power and risk acts as a wake-up call for any management layers in a corporation, especially the board of directors, to pay more attention to the risk-taking by powerful CEOs and ensure value-enhancing risk-taking strategies, because higher risk can eventually lead to excessive risk, which is detrimental to firms if not under cautious surveillance.

Similar signals and alerts are sent to other stakeholders, including shareholders and regulators, that put upward pressure on firms led by powerful CEOs. This is because the evidence provided serves as a stable governance tool that enables firms' top management teams to impose vigilant monitoring to maximise corporate profit and reduce costs related to risk-taking, investors to employ more rigid analyses of firms' risk-taking behaviours, and policymakers to apply relevant and prudential governance regulations related to risk, enhancing the health and sustainability of corporate environments and financial markets (Lewellyn & Muller-Kahle, 2012).

Furthermore, the empirical evidence offered in this study enhances international boards' and other senior decision-makers awareness and consideration of the relationship between CEO power and firm risk under the influence of worldwide health and financial crises (Sheikh, 2019). Policymakers constantly attempt to influence legislation to impose monitoring policies on firm activities, including risk-taking (Sheikh, 2019), specifically during or after times of crisis. The 2007 financial crisis and the 2020 COVID pandemic are among the riskiest events since the Great Depression of 1929-1932 (Moschonas, 2020). These two reveal the sheer vulnerability of the global economy and its impact on corporate risk-taking. Therefore, evaluating and examining the determinants of firm risk today is more critical than ever.

Chapter 3: FALLING IN TURBULENCES: EFFECTS OF CEO POWER ON EXTREME TAIL RISK ON G7 COUNTRIES

ABSTRACT

This paper investigates how CEO power affects firm tail risks and whether such effect varies during crises. Examining a sample of 12,761 firm-year observations from G7 nations from 2006 to 2021, we find that companies with more powerful CEOs are exposed to higher tail risks than those with less powerful CEOs. This holds for both idiosyncratic (firm tail risk) and systematic tail risk (market tail risk). During crises such as the financial crisis of 2007 and the recent COVID pandemic, the impact of CEO power on tail risk remains relatively unchanged. Furthermore, the findings are mainly driven by non-financial firms and firms with low R&D expenditure, indicating their risk-taking capacity. Our research provides valuable insights to policymakers, investors, regulators, and firms, including CEOs, to better manage risks in the future.

Key Words: CEO power; tail risk; Financial crisis; COVID-19 pandemic

1. INTRODUCTION

Decision-making involves a trade-off between feasible alternatives to achieve a strategic goal, solve issues, and avoid potential risks (Von Neumann & Morgenstern, 1944). Due to the magnitude of risk-based decisions, this is one of the major roles of chief executive officers (CEOs). CEOs are responsible for making strategic operations and planning decisions, a firm's productivity and profitability, relationships with stakeholders, the company's risk levels being controlled and evaluated, and organisational structure revisions (Finkelstein & Boyd, 1998). As such, decision-making is vital to manage different risks. As described in various extant studies (Bezzina et al., 2014; Marks, 2011; Stulz, 2008; Teschner et al., 2008; Jarrow & Turnbull, 2000; Jarrow, 2008), risk management is the process of controlling and managing risk within a company. Bezzina et al. (2014) refer to risk as unforeseeable (unfavourable) incidents that may or may not happen. Consequently, risk management plays a crucial role in businesses' financial performance, survival, long-term growth, and the consequences of CEO decisions, which are possible sources of firms' risk. Therefore, CEOS need to manage risks to increase the effectiveness of any firm by balancing internal and external risks and potential compensations.

Additionally, the risk-return framework of Markowitz (1952) outlines that higher returns can compensate for high risks. This suggests that a higher risk level can be perceived as a growth opportunity since it yields better returns that enhance the chance to meet shareholders' wealth maximisation objectives of firms. On the other hand, firms that undertake too little risk, i.e., too conservative in risk-taking, can oppose the objectives of shareholders, often viewed as risk-seeking principals. This is because conservative managers may choose to forgone value-enhancing but risky projects due to their risk-free investment strategies, yet they are value-diminishing to firms. In contrast, there is another aspect of risk that shareholders avoid, which is referred to as an inferior and suboptimal risk, i.e., tail risk. Tail risk captures the heavy-left tail of the probability distribution of the stock returns to observe the likelihood and occurrence of extremely adverse outcomes (Diemont et al., 2016). Tail risk is the excessive risk resulting from CEOs' inappropriate decisions (Bushman et al., 2018; Trinh et al., 2023). Consequently, risk management is challenging and decisive for CEOs to make risk-based decisions. In this regard, whether and how CEO characteristics impact firm risk and outcomes have attracted many researchers and practitioners over the last few decades (see, e.g., Çolak and Korkeamäki, 2021; Brisley et al., 2021; Fan et al., 2021; Neyland, 2020; Serfling, 2014).

Moreover, among many characteristics of CEOs is the power that enables CEOs to influence the firm's overall operations and strategic decisions (Grinstein & Hribar, 2004; Lewellyn & Muller-Kahle, 2012; Sheikh, 2019). However, to the best of our knowledge, very few studies explore the relationship*s* between CEO characteristics and firm tail risk (see such as Bushman, Davidson, Dey, and Smith, 2018; Srivastav et al., 2017; and Wang and Fung, 2022).

To address the gap in the literature, this study aims to examine the relationship between CEO power and firm tail risk and its influence during financial and health turbulences. Specifically, we employ a cross-country panel data sample containing publicly listed firms in G7 countries: the United States, the United Kingdom, Germany, France, Italy, Canada, and Japan. The investigation covers a period from 2006 to 2021 with 12,761 firm-year observations. This period includes the global financial crisis 2007 and the ongoing COVID-19 crisis. The contribution of this study is three-fold. First, prior studies that explore the relationship*s* between CEO characteristics and firm tail risk has predominantly focused on CEO attributes such as materialism, forced turnover, and gender (e.g., Bushman, Davidson, Dey, and Smith, 2018; Srivastav et al., 2017; Wang & Fung, 2022). To the best of our knowledge, this study stands out as a novel investigation examining the relationship between CEO power and firm tail risk. Second, extending prior studies that confine their research to a single country (e.g., Bushman, Davidson, Dey, and Smith, 2018; Wang & Fung, 2022), our study encompasses an international sample of G7 countries. Therefore, findings are more generalisable and applicable in a broader context, offering a more insightful picture extending beyond national boundaries. Third, our study employs the most recent dataset, spanning the period from 2006 to 2021, which is important after a series of market events such as the COVID-19 pandemic, the financial crisis, and many changes in governance codes around the globe. According to Eisenkopf, Juranek, and Walz (2023), the onset of COVID-19 in early 2020 was incredibly severe, leading many experts to say this crisis is distinctive from other previous crises, starting from the health exposure nature that it carries. The COVID-19 health shock drastically caused major economic and financial problems, and various institutional and governmental actions and responses to the incidents are unique and have never been encountered in history. According to the International Monetary Fund (IMF), COVID-19 has negatively affected global economic growth on a scale not experienced since at least the global financial crisis of 2008-09. Guedhami et al. (2023) note that the undesirable economic consequences of COVID-19 and the government responses have been wide-ranging and felt across labour, capital, and financial markets, as well as by firms and households.

Therefore, the reactions and decisions made by the most senior managers in corporations during this health crisis remain an uncovered aspect to study further. Our study provides further insight into this topic to understand how CEOs would utilise their power during the health crisis and whether CEOs with power harm firms through higher tail risk. The study draws practical implications on the sustainability of firms during the health crisis, which are distinct from other crises of a financial nature.

Under the baseline model, we show a significant and positive impact of CEO power and tail risk. By decomposing tail risk into idiosyncratic tail risk (ES-Idio) and systematic tail risk (ES-Sys), we observe that CEO power exerts statistically significant positive effects on both tail risk components. In other words, the CEO power affects both firm-born and market-born tail risk. To assure the validity and reliability of our main findings, we employ a few alternative models, including the lagged approach, fixed/random effects, the system General Method of Moment (GMM) and the 2-stage least square (2SLS), to control for the issue of endogeneity (Trinh et al., 2023; Li et al., 2023). The robustness checks conducted through these alternative models consistently validate our main findings. Furthermore, by employing the difference-in-difference (DiD) approach, we find that the relationship between CEO power and corporate tail risk is generally consistent across financial and health crises. This finding is statistically justified for DiD with interaction terms and DiD with the propensity score matching (PSM) method. CEOs with greater power and control are expected to be exposed to a higher propensity to take excessive risk, leading to higher tail risk, in both normal and turbulent economic and financial conditions.

This study has important implications for firms, investors, regulators, and policymakers. For example, policymakers can use the evidence of this study as a proactive tool to anticipate the impact of crises on investors and markets by analysing how CEO power affects corporate tail risk. Regulators may also establish improved rules and regulations to minimise risks and prevent future turbulences. Moreover, based on the recommendations, firms and investors can get deeper insights into managing tail risks associated with powerful CEOs. Hence. This study is useful for enhancing senior managers' hiring criteria and understanding the tail risk associated with powerful CEOs during crises. Furthermore, the board of directors and top management are suggested to delegate more power to CEOs to avoid extremely conservative and value-damaging CEO strategies and stimulate positive firm outcomes. The CEO's power is expected to work effectively and achieve a reasonable return on investment. At the same time, the board of directors should pay more attention to the risks raised by powerful CEOs' decisions. This is because higher risks are expected to increase the excessive risk, which is detrimental to firms' growth. In other words, overseeing powerful CEOs' decisions is more likely to help manage tail risk.

The structure of the remaining paper is as follows: Section 2 provides an explanation of tail risk in risk management. Sections 3 and 4 delve into the underlying theoretical background of the CEO power—tail risk relationship, thoroughly review the literature, and develop our hypotheses. Subsequently, Section 5 explores the sample and analytical methodology employed in the study, followed by the results section in Section 6, and Section 7 presents the conclusion.

2. TAIL RISK IN RISK MANAGEMENT

Various extant studies defined risk management as the process of risk control and corporate risk (Bezzina et al., 2014; Marks, 2011; Stulz, 2008; Teschner et al., 2008; Adam et al., 2015; Jarrow & Turnbull, 2000; Jarrow, 2008). Risk is viewed as unforeseeable (unfavourable) events with the possibility to occur (Bezzina et al. (2014). In this regard, Bezzina et al. (2014) and Marks (2011) suggested that risk is an inevitable investment component. In their study, they highlight that investors seem to adopt three factors to address and manage any potential risks effectively: understanding the risk, recognising the magnitude of the risk, and controlling the risk (Bezzina et al., 2014; Marks, 2011). As such, ISO 31000 (2009) revealed that risk management functions as systematic activities to effectively consolidate risk management processes in strategic objectives to manage an organisation (Bezzina et al. (2014). Thus, risk management is intended to control hazards and opportunities that are unexpected to occur (Stulz, 2008). Institutions should have a rational decision-making framework to prevent risk, which is the baseline for meeting firms' objectives (Power, 2007). As Teschner et al. (2008) proposed, effective risk management focuses on the human part in the decision-making to control and mitigate risk and maximise a company's value. Corporate risk management deals with heterogeneous risks, including market, bankruptcy, liquidity, and operational risks (see Jarrow and Turnbull, 2000, p. 587; Jarrow, 2008).

Various studies investigate the risk level of a firm, which can be most widely measured by stock volatility (Sheikh, 2019). This risk aspect captures the total risk embedded in the fluctuation of firm stock price and is the risk outcome of firms' risk-taking behaviours. Despite its importance and relevance, this risk level is a double-edged sword, so higher risk is not necessarily a bad outcome. According to the risk-return framework of Markowitz (1952), the higher risk goes in hand with a higher return. Given the risk-taking nature of shareholders who generally possess diversified investment portfolios, a higher risk level can yield higher returns, increasing the shareholders' values and achieving the core corporate objective (Gong, 2004; Jensen & Meckling, 1976).

Tail risk is considered excessive risk resulting from CEOs' inappropriate decisions (Bushman et al., 2018; Trinh et al., 2022; Trinh et al., 2023). Furthermore, Ellul (2015) noted that tail risk is an uncommon/extreme outcome that impacts institutional investments undesirably. Thus, investors are concerned with tail risk due to its subsequential extreme stock price decreases (Cohen et al., 2014). For instance, to a great extent, the financial crisis 2007 was amplified due to tail risk (Cohen et al., 2014). As such, in almost all circumstances, investors dislike and avoid corporations with higher tail risk (Hocquard & Papageorgiou, 2013). Tail risk is critical to study because it highlights the potential for extreme, adverse outcomes that traditional risk models often overlook. Unlike standard risks that can be modelled using normal distributions, tail risk focuses on the heavy left tail of probability distributions, which capture rare but devastating events (Diemont et al., 2016). While reputational and operational risks are important, they typically manifest over time and may not lead to immediate catastrophic losses. In contrast, tail risk encompasses sudden, severe downturns that can dramatically impact financial stability in a short period.

Understanding tail risk is essential for effective risk management, as it allows investors and institutions to prepare for "black swan" events, i.e., unexpected occurrences that can lead to significant losses (Taleb, 2007). Additionally, the psychological factors influencing market behaviour during crises can amplify these risks, making it vital to develop robust strategies that account for extreme market movements (Acerbi & Szekely, 2014).

In this respect, investors and regulators should be more aware of the tail risk to avoid sharp stock price declines and enhance the stock market's health and sustainability (Cohen et al., 2014). This risk must be prioritised because of its detrimental consequences to firms, threatening their financial health, financing prospects, and sustainability. More significantly, deteriorating market scenarios such as economic crises and dramatic drops in stock prices are most likely to trigger firms' bankruptcy and failure to recover from crises (Gregoriou et al., 2021). Therefore, following the financial crisis 2007, corporate risk management focused beyond market-based risks to include tail risk since it is more likely to decelerate financial markets and economic growth during crises (Cohen et al., 2014).

3. THEORETICAL FRAMEWORK

a. Theoretical framework: CEO power and tail risk

The primary corporate outcome of this study is the downside tail risk. As discussed, it captures firms' excessive risk-taking, i.e., an inferior and suboptimal risk aspect. The critical question in this section is which theoretical foundations a relationship between CEO power and tail risk is built on.

First, the agency theory of Jensen and Meckling (1976) suggests a negative relationship between CEO power and tail risk. In the simplest terms, the agency theory focuses on conflicts between corporate principals and agents that result in agency costs (Amihud & Lev, 1981; Sheikh, 2019). Disputes of this nature can be attributed to two primary sources: (1) asymmetry of information and (2) divergent goals and interests (De , Van Dick, Tenbrunsel, Pillutla, and Murnighan, 2011). Mainly, agency problems arise in environments with information asymmetry, which means that the external principals need to have or share the same knowledge as the agents. It is expensive to properly monitor and gain the same degree of such information possession (Wilson, 1968). Under the umbrella of information asymmetry, different and conflicting self-interests of individuals, corporate agents are inclined to pursue actions and make decisions that can be detrimental to firms and harm the principals' values.

The discrepancy in the risk-taking propensity between managers and shareholders is one of the primary concerns of the agency theory. It is often assumed that shareholders are risk-seeking individuals if they possess diversified investment pools and invest in equity, i.e., a high-risk investment type. In contrast, the managers tend to be conservative and risk-averse because of their limited sources of income and their strong dependence on the success of their managed organisations (Amihud & Lev, 1981; Wiseman & Gomez-Mejia, 1998)

It has been argued that managers, once reaching the top executive role like the CEO, are likely to lean toward conservatism to protect their status quo, including the generous compensation and benefits package, high profile, and reputation, primarily, the power that is provided to them as a CEO. As a result, risk-averse decisions can be implemented, damaging shareholders' values (Lewellyn & Muller-Kahle, 2012; Grinstein & Hribar, 2004). A powerful CEO would exhibit more freedom and ability to take actions that are in their best interest, even if it conflicts with the interests of their shareholders, particularly as explained, risk-averse strategies as reported by previous studies, such as Grinstein and Hribar (2004); Lewellyn and Muller-Kahle (2012); Sheikh (2019); Fernandes et al., (2021), Pathan (2009), and Liu and Jiraporn (2010). Related to this view of tail risk, more risk-averse agents (due to higher power possession) are less likely to make excessive risk-related decisions. By walking on the safe road, the propensity of extreme stock loss of firms led by more powerful CEOs is lower, i.e., lower tail risk.

On another strand stated by the behavioural agency model of risk-taking (the BAM, Wiseman and Gomez-Mejia, 1998) in combination with the approach/inhibition theory of power (Keltner et al., 2003), a positive relationship between CEO power and tail risk is sketched. The BAM model has been developed to improve the explanatory power of agency-based models of executives' risk-taking behaviour by integrating the agency theory and prospect theory of Tversky and Kahneman (1986). It argues that there is a tendency for managers to be risk-seeking as well as risk-averse (in domains of loss and gain, respectively), whilst the conventional agency theory mainly supports the risk-averse attitudes of managers. Under the framework of this theory, CEOs can seek or avoid risks depending on their situation (Sawers et al., 2011). To link the tail risk aspect and CEO power, the inhibition/approach theory of power offers a more thorough insight.

According to the approach theory, power "transforms underlying psychological processes" of people, including their behavioural approach system (Keltner et al., 2003; Magee & Galinsky, 2008, p. 366). In contrast to behavioural inhibition, this approach system encourages people to focus more on desirable results (such as rewards and successes) (Karniol & Ross, 1996; Keltner et al., 2003). Regarding social psychologists, for example, Anderson and Galinsky (2006) found experimental evidence that power boosts risk-taking because powerful people are more optimistic about risk. The concept of CEOs' power is often accompanied by overconfidence in their abilities and skills (Akstinaite et al., 2021). In risky decisions, judgment errors are a significant concern for firms (Sah & Stiglitz, 1991; Adams et al., 2005). Thus, strong CEOs with more resources, fewer restraints, and less invigilation seem to direct their motivations, behaviours, and emotions on possible company successes and rewards (the trigger of the CEO approach system). Because of this, they become more engaged in behaviours of aggressive risk-seeking as a result of the cognitive bias being activated, which causes them to overlook the potential loss or threat they may face (Keltner et al., 2003; Lewellyn & Muller-Kahle, 2012). Consequently, the tendency to make excessive risk decisions is expected to increase with more powerful CEOs, leading to a higher possibility of extreme stock loss (tail risk).

4. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

This section illuminates CEO power, dimensions, and influences on firm strategic decisions and outcomes, as reported in the literature. This thorough review identifies the study's novel contributions and develops testable hypotheses.

a. CEO power and dimension of CEO power

First, glancing at the CEO's power in many different contexts is important. This power construct has been investigated in light of agency, decision-making, classifications, and influences on firms (e.g., Haleblian and Finkelstein, 1993; Finkelstein, 1992). A question has been put forward about how CEO power is determined, and Jensen and Meckling (1976) have referred to the answer to CEOs' duties. A firm serves as a nexus for contractual relationships in modern corporations. As far as corporate finance is concerned, this concept of "nexus of contract" dominates (Jensen & Meckling, 1976). They define the agency relationship as one that exists between ownership and control. Under the terms of this agency agreement, one or more people (the principals) appoint another person (the agent) to carry out all business-related tasks on their behalf (Jensen & Meckling, 1976). A company's proprietors (shareholders) choose the board of directors. The board is responsible for selecting a CEO to lead the company. The primary agents' (CEOs') responsibility is to manage the company's operations and capital assets, including its human and physical resources, to maximise shareholder wealth.

Therefore, the CEOs can utilise their ability to make decisions, plan all input actions, and execute contracts with other stakeholders. The CEO position is at the top of the organisational hierarchy, and hence, without a doubt, it provides them considerable power within a company. Adams et al. (2005) state that "top executives not only have ultimate control over a company's operational decisions but also significantly impact the strategic decisions of a company." According to Finkelstein and D'Aveni (1994), the influences of the CEO may either improve or impede a company's success. In other words, the CEO positively impacts negotiations and improvement of management performance in tumultuous situations. Conversely, CEOs may adopt entrenchment to maximise their self-interests and wealth. The greater their power, the greater their influence on their firms. Consequently, CEO power has attracted more and more attention from academics and practitioners.

Different types of CEO power have been proposed in the literature, such as forced and non-forced power (Hunt & Nevin, 1974) and economic and non-economic power (Brown et al., 1983). In addition, numerous scholars have decomposed CEO power into other dimensions. For instance, personal power and structural power are two of the aspects of power proposed by Krishnan and Sivakumar (2004); positive and negative power discussed by Finkelstein and D'Aveni (1994); and formal and informal power in the study by Pfeffer (1992). Among many studies, a survey by Finkelstein (1992) is one of the most influential studies in management. The study described CEO power as "the capacity to manage sources of uncertainty, both internal and external." There are four types of executive power: structural power, expert power, ownership power, and prestige power. Numerous academic studies have used these four verified aspects of power to analyse CEO power (e.g., Lewellyn et al., 2012; Daily & Johnson, 1997).

b. CEO power and corporate strategic decisions and outcomes

This section discusses the impacts of CEO power on corporate decisions and outcomes. The Chief Executive Officer is the highest C-suite[4] Position. According to Hambrick and Mason (1984), the senior management team dominates the company and directs organisational outcomes through its strategic objectives. As such, it has been suggested that CEO power is more critical than other CEO characteristics in determining a company's strategic direction and outcomes. For instance, Le, Kweh, Ting, and Nourani (2022) explored how the influence of CEO power affected earnings management. The sample was gathered from publicly traded Vietnamese firms between 2007 and 2016. Their study used the CEO's financial expertise and founder as proxies to evaluate CEO power. According to this study, CEO power significantly and positively impacted earnings management.

The composition of a firm's board has also been found to be influenced by CEO power. Baldenius et al. (2014) focused on the CEO's power in a firm's board nominations. This study assumed that CEOs with power tend to appoint a board that is overly concerned with monitoring. On the other hand, shareholders were inclined to pick a board heavy on advisers. The CEOs nominated to the board tended to entrust decision-making power to the CEO, which increases the CEO's risk of entrenchment. Furthermore, the power of the CEO on board gender diversity is positively influenced by this study. Additionally, a firm's board diversity is

[4] C-suite is made up of seven people with titles that start with "chief," including the CEO, the CFO, the CIO, the CMO, the general counsel, and the chief human resources officer (Groysberg, Kelly, & MacDonald, 2011)

positively associated with CEO power. In particular, the impact of the power of the CEO on boards' gender diversity was conducted by Brodmann, Hossain, and Singhvi (2022). As this study concluded, the link between gender diversity and CEO power is most strongly influenced by companies with a younger board, a larger board, and if institutional ownership is higher. Data for this study covers the period from 2003 through 2017. This study used the founder, the CEO/Chair duality, the CEO pay slice, and tenure as proxies for power.

Another study by Chu, Liu, and Chiu (2022) explored the relationship between CEO power and corporate social responsibility performance. This study examined several publicly traded US businesses from 2000 to 2018. Their research employed the CEO's share ownership as a proxy of CEO power. The study reported that firms with powerful CEOs are less likely to undertake CSR activities, and younger, overconfident, and more competent CEOs increase the negative relationship between CEO power and CSR. In contrast, female CEOs were recorded to moderate such relationships negatively.

Similarly, Jiraporn and Chintrakarn (2013) used a sample of 1370 firms from 1995-2007 to study the opinion of powerful CEOs on corporate social responsibility (CSR) investments. This study used the CEO pay slice as the primary proxy for CEO power. This study found that CEOs with less power engaged in CSR more often than CEOs with more power. However, CEO power and CSR investments do not have a monotonic relationship, as shown by the results of this study. Using the agency perspective, Jiraporn and Chintrakarn (2013) explained how CEOs benefit from compensation and other bonuses from investing in CSR projects.

Furthermore, the moderating effect of CEO power on the link between divestiture strategy and firm performance has also been investigated by Brahmana, You, and Yong (2020). Between 2012 and 2016, Malaysian non-financial public-listed companies were examined in this study. According to their findings, the divestiture strategy decreased firm performance. Nevertheless, with more powerful CEOs, such a reduced effect is lessened but does not lead to a performance increase. As such, this study focuses on the importance of CEO power in aligning organisations, the CEO's influence on strategic decisions, and important implications for corporate governance.

Chikh and Filbien (2011) also studied the impact of CEO power on acquisition-related decisions to examine how the market reacted to announcements of acquisitions. As a result of the market turning in the opposite direction to the CEO's plans, the study suggested the CEOs of acquiring firms would discontinue any deals. In contrast, if CEOs have a good social network and power, as this study explained, they appear less likely to cancel any contracts regardless of market conditions. Using the Securities Data Company's (SDC) database for 2000-2005, the authors tested 200 French acquisition announcements. This study used ownership, expertise, structure, and prestige as proxies for power. According to the findings of this study, CEOs with strong positions (as the chair of the board), social networks, and acquisition experience tended to be self-confident. In general, regardless of market investor acceptance of the merger, the power of the CEO and social networks boosted the likelihood of a merger closing.

CEO characteristics and firm tail risk

The CEOs play an essential role in controlling different risks to advance their companies. Over the past two decades, a considerable amount of corporate governance research has highlighted the impact of CEO characteristics on firm risk. Specifically, the research stream described that the CEO's characteristics, including age, gender, social status, appearance, yearly incentives, self-confidence, political worldview, cultural beliefs, and social network, seem to be tangible indicators of firm risk (see, e.g. Brisley, Cai, and Nguyen, 2021; Fan et al., 2021; Neyland, 2020; Kamiya et al., 2019; Faccio et al., 2016; Serfling, 2014; Çolak, and Korkeamäki, 2021; and so on). However, to the best of my knowledge, very few studies research relationships between CEO characteristics and firm tail risk, such as Bushman, Davidson, and Smith (2018), Srivastav et al. (2017), and Wang and Fung (2022).

The effect of CEO materialism on bank tail risk has been investigated by Bushman et al. (2018). The data incorporated CEOs' ownership of boats, vehicles, and real estate, extracted from various federal, state, and county databases retrieved by licensed private investigators. In this study, real estate data coding was done by hand, and public information was utilised primarily from county tax assessor websites. Furthermore, they acquired consolidated financial information of bank holding companies (BHCs) from the FR Y-9C reports uploaded to the Federal Reserve System. Additionally, they obtained stock price data from the CRSP database from 1992 through 2013. The study results illustrated a significantly positive connection between materialism and the tail risk of the firm.

Srivastav et al. (2017) reported a relationship between tail risk and the CEO's forced turnover. As this study explained, there was a high possibility of a forced CEO turnover in large financial institutions and banks due to the positive relationship between CEO's forced turnover and idiosyncratic tail risk. Most significantly, members of the board of directors seemed not too supportive of CEOs in their banks because CEOs were willing to take undue risks. This is crucial for the financial firms' performance since CEOs are more likely to jeopardise their financial institutions by not controlling the institutional and bank risks (i.e., extreme negative stock returns). This study employed various measures to assess the bank's tail risk exposure based on governance information gained from relevant databases, including Bloomberg, Business Week, Forbes, and S&P Capital IQ, from 2004 to 2013.

Additionally, Wang and Fung (2022) study explored the influences of female CEOs and CFOs on tail risk and firm value. Their study employed expected shortfall and Value-at-Risk to gauge the tail risk to gauge the tail risk. This study used Taiwan data to collect data for 1313 firms licensed by Taiwan Stock Exchange Corporation or Taipei Exchange from 2009 to 2020. They reported that firms led by female CEOs were more likely to influence tail risk positively. On the contrary, firms that hired female CFOs were more likely to promote a negative effect on tail risk.

It appears that teams led by CEOs, as the top manager, are most likely to meet firms' objectives to enhance their stock price and returns. Possibly, such groups seek to secure a sound financial status for their firm, increase their incentives, decrease the likelihood of firms' takeover, maintain a decent reputation in the media, and meet the goals of all stakeholders (Fairfield, 2020). In this respect, the media and stakeholders seem to be effectively watching and reporting stock prices, indicators of companies' performance (Fairfield, 2020). To conduct the present study, it is necessary to observe stock price returns to explore the relationship between CEO power and tail risk. The following section will discuss the development of the CEO power and tail risk relationship.

Overall, this section shed light on a body of research that explored the influence of CEO characteristics, materialism, gender, and turnover on firm tail risk. Adding to this research stream, the current study investigates the CEO's power as a potential indicator of a firm's tail risk. This is the primary academic novelty of this paper.

c. Hypothesis development: CEO power and firm tail risk

A growing strand of literature focuses on CEO power's potential impacts on firm risk outcomes (Fernandes et al., 2021; Pathan, 2009; Sheikh, 2019; Lewellyn & Muller-Kahle, 2012). Nevertheless, reported findings remain inconclusive, with a negative relationship between banks (Fernandes et al., 2021; Pathan, 2009) and a positive relationship between non-bank organisations (Sheikh, 2019; Lewellyn & Muller-Kahle, 2012). Thus far, to the best of my knowledge, studies have yet to be conducted on the relationship between CEO power and firm tail risk despite its criticality for firms and the whole economy and financial market.

As thoroughly discussed, tail risk captures the probability of extreme stock loss in value, which is argued to be a result of firm inferior aggressive risk-taking behaviours. According to the theoretical backgrounds underpinned by the CEO power – tail risk relationship as discussed in Section 3.a, the agency theory provides indicators of a decreased tail risk with CEO power because powerful CEOs exhibit a more risk-averse propensity to protect their status quo from detrimental events (Jensen & Meckling, 1976). Due to such risk-aversion, it is less likely for those CEOs with power to overlook the consequences of excessive risk decisions to their career, reputation, and, of course, their current holding power. Consequently, based on this agency view, we propose that firms led by more powerful CEOs are exposed to lower tail risk.

On the other side of the coin, the behavioural agency theory (BAM) and the approach/inhibition theory suggest the opposite (Wiseman & Gomez-Mejia, 1998; Keltner et al., 2003). First, whilst the conventional agency theory argues for (against) the existence of risk-averse (risk-seeking) agents, the BAM states that corporate agents can be risk-seeking as well as risk-averse individuals. Therefore, it is possible (based on the BAM) for a powerful CEO to be risk-seeking. Complete the BAM's prediction, the approach/inhibition theory suggests that an individual's approach system is stimulated by power, which triggers them to be more positive, optimistic and confident about the outcomes. Consequently, powerful agents pay more attention to rewards and achievement than risk and failure (Keltner et al., 2003; Karniol & Ross, 1996; Anderson & Galinsky, 2006). Supporting such a view, Adams et al. (2005) and Sah & Stiglitz (1991) reported an increase in CEO's overconfidence about their skills and ability when they have stronger power. As a result, more powerful CEOs may be more inclined to commit to aggressively risky activities, leading to higher tail risk.

Overall, the prediction of the correlation between CEO power and tail risk needs to be visible due to two-sided theoretical views. Consequently, the following non-directional hypothesis is developed and tested:

H1: CEO power is significantly correlated with firm tail risk

d. *Moderating effects of Financial and Covid-19 crises*

In addition to the direct effect of CEO power on firm tail risk, our study also investigates whether such effect changes during financial turbulences. Recently, financial markets have shown moments of economic instability and turmoil. Laborda and Olmo (2021) describe these periods as extreme uncertainty, leading to a significant increase in stock market volatility. During crises, asset interdependence and financial market interconnection are critical. They can trigger systemic risk episodes, as demonstrated during the global financial crisis of 2007, the Eurozone debt crisis between 2010 and 2012, and the COVID-19 pandemic crisis of 2020 (Laborda & Olmo, 2021; Diebold & Yilmaz, 2015). During these turbulences, the trust and tolerance of shareholders are tremendously shaken, triggering their negative emotions, including anger and resentment of firms, leading to potential stock retirement and, hence, extreme falls in stock values (i.e., tail risk) (Fediuk et al., 2010). That is why firms are often exposed to greater risks of stock price depreciation during crises, heightening their pressure and caution. Such intensified stress is likely to modify the way CEOs utilise and are influenced by their power during crises, impacting extreme stock depreciation. It is expected to differ in comparison to "normal" operational circumstances. Consequently, we develop and test for the following hypothesis:

H2: The relationship *between CEO power and tail risk is significantly affected by the crisis*

Referring to the "crisis" stated in H2, we specify the moderating effects of the financial crisis in 2007 and the COVID-19 crisis in 2020. It is important for such distinguishment due to their differences in nature. These two crises affected the world economy and financial markets (Chen & Yeh, 2021; Laborda & Olmo, 2021). It is important to note that the global economic crisis did not only affect the economy but also household-debt bubbles, tourism, health care, and education issues. Similarly, COVID-19 has expanded into a global health crisis that has impacted the global economy, exports, and industries. (KOF, 2021) Non-economic factors accelerated this crisis. In terms of economic recession, both crises were semi similar. Due to its uncertainty, a global effect like this is impossible to predict; therefore, it is impossible to avoid. Due to uncertainty, risk cannot be quantified or forecasted, as Knight (1921) explains. Economic consequences seem to apply to Covid-19 (Marc-Olivier Strauss-Kahna, 2020). However, such uncertainties must be traced and analysed regularly for global consequences to be mitigated.

Moreover, it is also important to note that the international economy recovered faster after COVID-19 than after the global financial crisis 2007. Perhaps a non-economic element led to COVID-19 (KOF, 2021). As they reported, national and global interventions were required to mitigate the effects of pandemics on the world economy. Thus, improving the global health situation could decrease the consequences of COVID-19 on the worldwide economy. The global health and economic crises have taught us many lessons.

Most importantly, crises can be used as powerful tools to improve the global economy. They provide invaluable lessons and insights, empowering us to make better decisions. The financial and COVID-19 crises have taught us, among other things, that world economists should routinely and thoroughly re-examine how vulnerable their economies are (KOF, 2021). Effective planning and forecasting can lessen the risks of unforeseen crises or economic deficits that could impede the expansion of the global economy (KOF, 2021). Using scenarios and forecasting factors, experts could revisit the causes and effects of global finances, further empowering us with knowledge and understanding.

5. METHODOLOGY

A cross-country panel data sample of publicly registered companies in the G7 countries was employed: the United States, the United Kingdom, Germany, France, Italy, Canada, and Japan. This study investigates the years between 2006 and 2021. The recessions of the COVID-19 health crisis and the global financial crisis were considered during this period. Specific databases were used to collect financial data, governance compositions, and macroeconomic data. The comprehensive nature of our data collection, utilising sources such as Refinitiv DataStream for financial accounting data, WRDS BoardEx for governance-related data, and macroeconomic data from the World Bank and the International Monetary Fund (IMF), ensures the robustness of our research.

Data on board and CEO compositions for all G7 firms were retrieved from WRDS Boardex, the leading governance data database. Consequently, the firm list was more comprehensive than if it was based on market indexes. After missing values were removed, a final sample of 12,761 firm-year observations was used in this study. We winsorise all accounting variables at the 1st and 99th percentiles to eliminate outliers.

a. Dependent variable: Firm tail risk

The study employs three proxies to measure firm tail risk: Expected Shortfall (ES), systematic expected shortfall (ES-Sys), and idiosyncratic expected shortfall (ES-Idio). These three measures of corporate tail risk were widely used in the literature (e.g., Srivastav et al., 2017; Wang and Fung, (2022); Trinh et al. (2023)). Following Wang and Fung (2022), Trinh et al. (2023), Aljughaiman and Salama (2019), and Srivastav et al. (2017), we calculate the following tail risk measures.:

1) Total tail risk - Expected Shortfall (ES): It highlights the negative value of the average firm's stock loss of the 5% worst returns annually ($\alpha = 5\%$). Its function can be processed as follows:

$$ES_{ai,t} = -E\left(R_{i,t} \middle| R_{i,t} \leq R_{ai,t} \right) \tag{1}$$

2) Tail risk's components - Systematic Expected Shortfall (ES-Sys) and Idiosyncratic expected shortfall (ES-Idio): These two tail risk measures capture the extreme stock loss arising from cumulative macro shocks (market-based tail risk) and firm-specific shocks, respectively. They are calculated as the negative values of the average day-to-day predicted and residual returns recorded as the 5th percentile of the yearly distribution, respectively. The daily residual and predicted returns were obtained using the following model:

$$R_{i,t} = \beta_1 + \beta_2 R_{m,t} + \beta_3 R_{b,t} + \mu_{i,t}$$
$$\Leftrightarrow R_{i,t} = Pred_{i,t} + Res_{i,t} \tag{2}$$

Where $R_{i,t}$ is the daily stock return of a given firm i at time t, $R_{m,t}$ is the daily prices for the main index for every country separately; and $R_{b,t}$ is the average daily stock revenue for every single industry in the main index for every country individually. Furthermore, the systematic and idiosyncratic tail risk measures (ES-Sys and ES-Idio, respectively) are calculated as follows:

$$ES_{\alpha\, Idiot} = -E\left(R_{i,t} \middle| R_{i,t} \leq \mu_{a\, i,t} \right) \tag{3}$$

$$ES_{\alpha\, Sys} = -E\left(R_{i,t} \middle| R_{i,t} \leq Pred_{a\, i,t}\right) \tag{4}$$

b. Main independent variable: CEO power

The primary explanatory variable is CEO power measured by the CEO pay slice (CPS), i.e., CEOs' relative compensation among the top five-earning executives. This measure has been used increasingly in the past few years as a proxy for CEO power by, for example, Bebchuk, Cremers, and Peyer (2011), Ferris et al. (2017), Chen et al. (2013) and more. Compared to others, it is more objective, useful, and advantageous due to its ability to capture "the relative centrality of the CEO in the top management team" (Finkelstein, 1992; Liu & Jiraporn, 2010, p. 748). Furthermore, it offers solid explanations for a firm's performance (Bebchuk et al., 2009; Bebchuk et al., 2006). In addition, the CPS is computed by utilising the compensation of executives from the same companies. Put another way, firm-specific characteristics are considered (Bebchuk et al., 2009). In line with the literature's approach, the CEO pay slice is calculated as the per cent of a CEO's total compensation compared to the top-five executives. CPS can be calculated mathematically as follows:

$$CPS = \frac{CEO\ total\ compensation}{\sum Top\text{-}five\ executives'\, compensations\ (including\ CEO)} \tag{5}$$

Liu and Jirapor (2010) noted that CEO power is not an easily observable characteristic, and extensive discussion has been conducted to identify more objective proxies for CEO power (Pfeffer, 1981; Provan, 1980; Salancik & Pfeffer, 1974). Several proxies are employed by the existing literature, e.g., CEO duality, CEO tenure, and board independence etc. (see, e.g., Pathan, 2009; Haynes & Hillman, 2010; Chikh & Filbien, 2011; Zhu & Chen, 2015; Sariol & Abebe, 2017; Onali et al., 2016; Daily & Johnson, 1997; Lewellyn & Muller-Kahle, 2012). In this study, the CEO pay slice is employed as the main measure, and these mentioned alternatives will be used as robustness checks.

c. Controlling variables

This study employed three groups of controlling variables which exhibit potential influences on firm tail risk, as reported in the literature.[5]: (1) firm-related financial characteristics, (2) corporate governance: CEO characteristics and board compositions, and (3) macroeconomic

[5] (See e.g., Yung and Chen, 2018; Wang, 2011; Milidonis, Nishikawa, and Shim, 2019; Coles, Daniel, and Naveen, 2006; Seo, and Sharma 2018; John, Litov, and Yeung, 2008; and Wang, and Fung, 2022)

factors at the country level. As firm-specific controls, the study assesses the firm's size (logarithm of its total assets), sales growth (percentage growth in sales), profitability (EBITDA/total asset), R&D cost (percentage of total assets), growth opportunities (market to book ratio), asset tangibility (percentage of net fixed assets in total assets), market leverage, dividend cut (dummy variable), cash surplus (percentage of cash surplus to assets). Additionally, corporate governance variables and CEO characteristics were assessed. These variables include the number of directors on the board, the percentage of female directors on the board, the age and gender of the CEO, the wealth delta of the CEO, and the tenure and education of the CEO. In addition, macroeconomic variables were considered, including the annual growth rate of the Gross Domestic Product (GDP), the annual inflation rate, foreign direct investment, trade per capita GDP, and dummies for the financial crisis and COVID-19 health crisis. The definitions and computations of these variables are explained in Table 1.

VARIABLES (ABBREVIATION)	*DEFINITIONS & MEASURES*	*CITATIONS*	*Data Source*
Firm size (SIZE)	Firm total asset = ln (TA)	Yung and Chen (2018), Wang (2011), Bernile, Bhagwat, Yonker (2018), Sanders and Hambrick (2007), Coles et al. (2006), Faccio et al. (2016)	Refinitiv DataStream
Sales Growth (Growth)	The annual growth rate in sales = $\ln(\frac{Sale_T}{Sale_{T-1}})$	Yung and Chen (2018), Fan et al. (2021), Faccio et al. (2016), Kamiya et al., (2019)	Refinitiv DataStream
Profitability (Profit)	Corporate earnings = $\frac{Earnings\ before\ interest, tax, depreciation, amortisation}{Total\ asset}$	Yung and Chen (2018), Bernile et al. (2018), Fernández-Méndez, and Pathan, (2022)	Refinitiv DataStream
R&D expense (R&D%)	% Research and development expense to total asset = $\frac{R\&D\ expense}{Total\ asset}$	Yung and Chen (2018), Bernile et al. (2018), Coles et al. (2006), Sila, Gonzalez, and Hagendorff, (2016)	Refinitiv DataStream
Growth opportunity	Market to book value ratio	Yung and Chen (2018), Wang (2011), Coles et al. (2006), Bernile et al. (2018)	Refinitiv DataStream
Asset tangibility (CAPEX)	% Net fixed asset to total asset = $\frac{Net\ PPE}{Total\ asset}$	Yung and Chen (2018), Bernile et al. (2018), Coles et al. (2006), Faccio et al. (2016)	Refinitiv DataStream
Market leverage (Leverage)	% of debt financing to firm market value = $\frac{Short-term\ debt + Long-term\ debt}{Total\ assets - Book\ equity + market\ equity}$	Yung and Chen (2018), Bernile et al. (2018), Coles et al. (2006)	Refinitiv DataStream

Surplus cash (Cash_surp)	% surplus cash to total asset = $\frac{Operating\ net\ cash\ flow - Depreciation\ and\ Amortisation + R\&D\ expense}{Total\ Assets}$	Yung and Chen (2018), Wang (2011), Almeida, Campello, and Weisbach (2004), Bernile et al. (2018), Fan et al. (2021), Sila et al. (2016)	Refinitiv DataStream
Dividend cut (Div_cut)	The dummy variable takes the value of unity if the annual dividend payout is reduced and zero otherwise.	Yung and Chen (2018), Benito and Young (2003), Ali (2021)	Refinitiv DataStream
Board size (Board_size)	Number of directors on the firm board of directors	Yung and Chen (2018), Wang (2011), Fan et al. (2021), Sila et al. (2016), Deutsch, Keil, and Laamanen, (2011)	WRDS Boardex
Female representation (%female)	The fraction of female directors on the board	Sila et al. (2016), Chen, Leung, Song, and Goergen, (2019), Faccio et al. (2016)	WRDS Boardex
CEO age (CEO_Age)	The biological age of the CEO (in years)	Coles et al. (2006), Fan et al. (2021), Serfling, (2014), Benischke, Martin, and Glaser, (2019), Faccio et al. (2016)	WRDS Boardex
CEO tenure (CEO_Tenure)	Number of years that the CEO has been holding their positions	Cain and McKeon (2016); Coles et al. (2006); Hirs); Chikh et al. (2012); Ferris et al. (2017); Hagendorff and Vallascas (2011); Onali et al. (2016); Chikh and Filbien(2011).	WRDS Boardex
CEO gender (CEO_fem)	The dummy variable takes the value of unity if the CEO is female and zero otherwise.	Fan et al. (2021), Benischke et al., (2019)	WRDS Boardex

CEO wealth delta (Delta)	The change in dollar value of CEOs' wealth for one percentage point change in stock price	Yung and Chen (2018), Coles et al. (2006), Sila et al., (2016), Kini, and Williams, (2012)	WRDS Boardex
CEO Education (CEO_Edu)	The dummy variable takes the value of unity if the CEO has master or above and zero; otherwise.	Fan et al. (2021); Bowen et al. (2010); Kim and Lu (2011); Cain and McKeon (2016); Ferris et al. (2017); Li et al. (2019); Haynes et al. (2019)	WRDS Boardex
Financial crisis (Crisis_F)	The dummy variable takes the value of one if the firm-year observations fall in the global financial crisis period 2007-2009 and zero otherwise.	Bastos and Pindado (2013), Hlaing and Kakinaka (2018)	
Covid crisis (Crisis_C)	The dummy variable takes the value of one if the firm-year observations fall in the COVID-19 crisis period 2020-2021 and zero otherwise.	Shehzad, Xiaoxing, and Kazouz, (2020), Chen, and Yeh (2021)	

d. Data analysis: Estimation models

As the baseline method, we employed Ordinary Least Squares with clustered standard errors at the firm level to test the hypotheses we presented in Section 4. The following regression models will be performed:

$$ES_{i,t}/ES_{Idio_{i,t}}/ES_{Sys_{i,t}} = \alpha_{i,t} + \beta_1 CPS_{i,t} + \varphi X_{i,t} + Year.FE + Industry.FE + Country.FE + \epsilon_{i,t} \quad (6)$$

Three main tail risk measures are utilised as dependent variables: the expected shortfall ($ES_{i,t}$), idiosyncratic tail risk ($ES_{Idio_{i,t}}$), and systematic tail risk ($ES_{Sys_{i,t}}$). CEO power was measured by CPS, which is the main independent variable. Moreover, β_1 captures the effect of CEO power on firm tail risk. $X_{i,t}$ is a vector of control variables as discussed and explained in Section 5.c and Table 1. Lastly, year, industry and country fixed effect dummies are controlled to tackle the issues of time-invariant unobservable factors. In addition, inconstant and correlated error terms were handled using clustered standard errors to deal with heteroskedasticity and autocorrelation. Even when the error terms were not independently and identically distributed (i.i.d), this cluster option was claimed to provide true standard error (Abadie et al., 2022; White, 1980). We employ several estimation approaches to deal with endogeneity: the lagged approach, fixed/random effects, the system General Method of Moment (GMM), and the 2SLS model. To further ensure the robustness of our findings, we employ two additional measures of tail risk. These are the marginal expected shortfall (MES) and the value at risk (VaRisk). The MES is the average return for a firm's stocks during the 5% worst return days for the market during a year. Additionally, the VaRISK measure was processed as the negative value of the stock return at a 95% confidence level for every firm annually (Trinh et al., 2023; Milidonis et al., 2019).

6. EMPIRICAL FINDINGS

a. Descriptive statistics and pair-wise correlation matrix

Table 1 illustrates a descriptive statistic for all variables in this study covering the 15 years between 2006 and 2021. All variables are winsorised at 1% to preclude the effect of outliers on obtained findings (Kim & Lu, 2011). In terms of average values, the three tail risk measures, expected shortfall (ES), idiosyncratic expected shortfall (ESIdio), and systematic expected shortfall (ESSys), are -1.855, -1.815, and -1.966, respectively. These are equivalent to 0.056, 0.062, and 0.040, respectively. The mean figures of these main measures of tail risk are like previous studies conducted on financial and non-financial firms (e.g., Aljughaiman, Cao, and Albarrak, 2021; Magee et al., 2019; Trinh et al., 2023). On average, the worst 5% trading days' stock returns yield a loss of 5.6%, i.e., the total tail risk, where 6.2% is from firm-specific factors and 4.4% is from market-based factors. Regarding CEO power, CEO compensation packages are approximately 25% of the top five earning directors of companies' salaries, about the main independent variable, CEO pay slice (CPS). Li, Gong, Zhang, and Koh's (2018) findings support this statistic. As a result, CEOs are typically the highest-earning directors in a company. CEO age (CEO_Age) ranges between 41 and 85 years; 5% of the full sample is female CEOs. CEO delta (Delta) wealth was, on average, 2.9, while maximum deltas were 9. The mean CEO delta implies that CEO wealth (in dollar terms) increases by three percentage points for every one percentage point increase in the stock price of their operating firms. Regarding CEO tenure (CEO_Tenure), the average is 1.3 years of service, the median is 1.2 years, the minimum is 0 years (less than one year, newly appointed CEOs), and the maximum is three years. The statistics also show that more than half of CEOs in the full sample completed higher education, i.e., a master's degree (Mean (CEO_edu) = 53.5%).

Regarding firm financial characteristics, the average company size (SIZE) is 12.425 log points. This average is within the range of 5.7 at the minimum and 18.6 at the maximum, aligning with the statistics observed in the Faccio et al. (2016) study. Furthermore, a negative 9% average profitability (Profit) is recorded with an average market-to-book value of 2.86, consistent with the study of Ji, Peng, Sun, and Xu (2021). In other words, market participants valued the company's stock at 300% over its book value. Each firm spends around 13% on average of its total assets on research and development, as indicated by its R&D variable (R&D%). As for leverage, it ranges between 0% (for unlevered firms) to approximately 74.5% and an average value of 15.5%, which aligns with Coles et al. (2006). With corporate governance factors, the average number of directors (Board_size) appointed on a board is eight, with a median value of seven, which aligns with Yung and Chen (2018). The data used in this study shows an average of 10.7% female representation (%female) on board and a median of 8%, similar to Bernile et al. (2018) study. Lastly, 49,256 and

32,912 firm-year observations, representing 19% and 13% of the sample, fall in the financial crisis (Crisis_F) period 2007-2009 and the COVID-19 (Crisis_C) period, respectively.

Regarding macroeconomic variables, GDP growth, inflation rate, foreign investment, and trade as a percentage of GDP, derived from a dataset comprising 119,548 observations, GDP growth exhibits a mean value of 1.052, with observed values spanning from -9.396 to 6.869. Inflation demonstrates moderate variability, with an average of 1.785 and a range between -2.312 and 5.348. Foreign investment shows substantial variation, averaging 2.275, ranging from -1.17 to 11.929. Trade as a percentage of GDP has the highest mean at 42.208, reflecting significant cross-economy variation, ranging from 23.376 to 88.434.

Table 1: Variable Descriptive Statistics for Full Sample

Table 1 illustrates the descriptive statistics of all variables employed in the study. ***ES*** refers to the negative value of the average firm's stock loss of the 5% worst returns annually, ***ES_Idio*** refers to the negative values of the average of the day-to-day residuals returns that are recorded as the 5th percentile of the yearly distribution, ***ES_Sys*** refers to the negative values of the average of the day-to-day predicted returns that are recorded as the 5th percentile of the annual). ***CPS*** is defined as the total compensation of CEOs against the total compensation of the top-five executives in individual firm percentages. ***CEO-Age*** CEO's biological age in years. ***CEO-female*** as dummy representation, one if the CEO is a female and 0 if not. ***Delta*** is a natural logarithmic representation of CEOs' wealth change in dollar value for one parentage change in stock price. ***CEO_Tenure*** is the natural logarithm of the time spent as a firm CEO. ***CEO_Edu*** dummy representation of 1 if the CEO owns a master's or above degree, or 0 if not. Size firm total asset logarithmic representation. ***Growth*** sales annual growth rate percentage. ***Profit*** earnings before interest payments and income taxes to total assets ratio. R&D is the percentage of research and development expenses to total assets. ***Growth _oppo*** the ratio of Market-to-book. ***CAPEX*** is defined as the percentage of net fixed assets to total assets. ***Div_cut*** dummy representation of 1 if the annual dividend payout decreased and 0 if not. ***Board_size*** is the total number of directors on the firm's board. ***% Female,*** the division of female directors on board. ***Financial and COVID crisis*** dummy representation of 1 if the observation of firm-year fall between 2007 to 2009 and between 2020 to 2021, respectively, and 0 if not**.** ***GDP_growth*** calculates the GDP growth (economic growth) percentage of the countries. ***Inflation_rate*** annual change percentage in the countries' consumer price index (CPI). ***Foreign_Inv*** calculates the percentage of foreign direct investment in the countries' GDP. ***Trade (% of GDP)*** calculates the % of the country's trade of their GDP.

Variable	N	Mean	p50	Std.Dev	Min	Max
ES	206011	-1.855	-1.952	.543	-2.571	2.349
ES-Idio	205096	-1.815	-1.953	.629	-2.303	2.451
ES-Sys	205579	-1.966	-2.092	.551	-2.64	2.451
CPS	75537	.241	0.222	.137	0	.75
CEO_Age	252493	63.456	63.800	9.023	41	85.111
CEO_ female	119806	.049	0.000	.215	0	1
Delta	76848	2.914	2.226	2.345	0	8.543
CEO_Tenure	263532	1.287	1.194	.746	0	3.199
CEO_Edu	99867	.535	1.000	.499	0	1
SIZE	239488	12.435	12.473	2.603	5.681	18.553
Growth	222624	.145	0.088	.44	-1.222	2.19
Profit	232304	-.088	0.048	.504	-3.315	.417
R&D %	128272	.133	0.030	.27	0	1.797
Growth_oppo	233888	2.869	1.690	7.286	-26.49	48.35
CAPEX	234496	.289	0.413	.839	-5.713	.997
Leverage	237264	.155	0.099	.172	0	.745
Cash_surp	127024	.25	0.149	.283	-.119	.961
Div_cut	136902	.167	0.000	.373	0	1
Board_size	239020	8.04	7.333	3.102	3	18.571
% Female	263532	.107	0.083	.121	0	.5
Crisis_F	263532	.187	0.000	.39	0	1
Crisis_C	263532	.125	0.000	.331	0	1
GDP_ Growth	119548	1.052	1.880	2.62	-9.396	6.869
Inflation_Rate	119548	1.785	1.850	.955	-2.312	5.348
Foreign_ Inv	119548	2.275	1.761	1.987	-1.17	11.929
Trade (% of GDP)	119548	42.208	30.790	17.45	23.376	88.434

Note: *The observation (N) is for each variable, which can differ from the observation of the regressions due to missing data once all variables are included in an estimation model.*

Table 2: Pairwise correlations matrix

Table 2 presents the correlation between all the variables analysed in this study. Bold coefficients signify statistically significant correlations at a 5% critical level or below.
Definitions for variables in Table are provided in sections 5.b and 5.c. The sample period ranges from 2006 to 2021.

Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**	**(19)**	**(20)**	**(21)**	**(22)**	**(23)**
(1) CPS	1.000																						
(2) CEO_Age	**-0.008**	1.000																					
(3) CEO_ female	**-0.071**	**-0.086**	1.000																				
(4) Delta	**0.348**	**0.089**	**-0.127**	1.000																			
(5) CEO_Tenure	**0.075**	**0.317**	**-0.049**	**0.164**	1.000																		
(6) CEO_edu	**0.058**	**0.019**	0.004	**0.190**	**-0.013**	1.000																	
(7) SIZE	**0.157**	**0.179**	**-0.006**	**0.586**	**0.113**	**0.033**	1.000																
(8) Growth	**-0.029**	**-0.100**	**-0.011**	**-0.044**	**-0.118**	**0.010**	**-0.120**	1.000															
(9) Profit	**0.028**	**0.121**	**-0.006**	**0.225**	**0.163**	**-0.045**	**0.468**	**-0.075**	1.000														
(10) R&D %	**-0.034**	**-0.122**	**0.014**	**-0.125**	**-0.148**	**0.108**	**-0.388**	**0.071**	**-0.652**	1.000													
(11) Growth_oppo	**0.011**	**-0.075**	**0.008**	**0.111**	**-0.064**	**0.026**	**-0.060**	**0.039**	**0.007**	**0.032**	1.000												
(12) CAPEX	**-0.027**	**0.075**	**0.021**	**-0.012**	**0.126**	**0.022**	**0.173**	**-0.026**	**0.505**	**-0.495**	**0.063**	1.000											
(13) Leverage	**0.025**	**0.070**	**-0.022**	**0.054**	**0.044**	**-0.023**	**0.327**	**-0.066**	**0.147**	**-0.209**	**-0.108**	**-0.109**	1.000										
(14) Cash_surp	-0.002	**-0.205**	**0.017**	**-0.017**	**-0.148**	**0.126**	**-0.342**	**0.138**	**-0.350**	**0.449**	**0.108**	**-0.098**	**-0.440**	1.000									
(15) Div_cut	**-0.026**	**0.015**	**0.037**	**-0.084**	**0.042**	**-0.048**	**0.162**	**-0.135**	**0.098**	**-0.116**	**-0.046**	**0.015**	**0.114**	**-0.146**	1.000								
(16) Board_size	**0.213**	**0.194**	**-0.025**	**0.635**	**0.069**	**0.052**	**0.675**	**-0.097**	**0.222**	**-0.184**	**-0.014**	0.001	**0.142**	**-0.206**	**0.084**	1.000							
(17) % Female	**0.034**	**-0.168**	**0.295**	**0.183**	**-0.046**	**0.030**	**0.205**	**-0.030**	**0.050**	**0.019**	**0.036**	**-0.034**	0.003	**0.023**	**0.083**	**0.203**	1.000						
(18) Crisis_F	**-0.010**	**0.023**	**-0.021**	**-0.015**	**-0.006**	**-0.007**	**-0.012**	**-0.010**	**-0.007**	**0.009**	-0.003	-0.002	**0.015**	0.001	**0.023**	0.002	**-0.034**	1.000					
(19) Crisis_C	0.005	**-0.047**	**0.050**	-0.003	0.003	0.003	**0.034**	**-0.025**	**0.004**	**-0.019**	-0.002	**0.012**	**0.012**	0.005	**0.062**	**-0.014**	**0.062**	**-0.129**	1.000				
(20) GDP_ Growth	**0.043**	**0.163**	**-0.057**	**0.137**	**0.018**	**0.025**	**0.033**	**0.125**	**0.041**	-0.003	**0.029**	**0.008**	**-0.033**	**-0.009**	**-0.169**	**0.071**	**-0.159**	**-0.275**	**-0.755**	1.000			
(21) Inflation_Rate	**-0.064**	**0.112**	**0.034**	**-0.153**	**-0.027**	**-0.016**	**-0.119**	**0.095**	**0.009**	0.005	**0.018**	**0.018**	**-0.043**	0.001	**-0.054**	**-0.070**	**-0.069**	**0.007**	**0.053**	0.001	1.000		
(22) Foreign_ Inv	**-0.130**	**0.061**	**0.007**	**-0.264**	**-0.043**	**-0.070**	**-0.146**	**0.058**	**-0.028**	0.000	0.005	**0.011**	**-0.038**	**-0.046**	**-0.030**	**-0.152**	**-0.127**	**0.139**	**-0.157**	**0.197**	**0.156**	1.000	
(23) Trade (% of GDP)	**-0.245**	**-0.159**	**0.052**	**-0.726**	-0.003	**-0.132**	**-0.191**	-0.004	**-0.050**	**-0.031**	**-0.024**	**0.038**	**-0.020**	**-0.114**	**0.112**	**-0.238**	**0.028**	**-0.034**	**0.009**	**-0.111**	**-0.042**	**0.295**	1.000

For each independent variable, Pearson's correlation matrices are shown in Table 2. Correlation pairs in the table are mostly weak, hovering around 0.5. The table does show a few notable exceptions. Profit and CAPEX (0.505), board size and delta (0.635), board size and firm size (0.675), and GDP growth and Covid crisis (-0.755) diverge from the weak zone. Since companies usually reinvest their profits after reaching higher profitability in fixed assets, profitability and CAPEX have a positive correlation. Additionally, CEO delta shows a positive relationship with firm size and board size, probably due to larger, more prestigious firms offering CEOs more incentives and stock-based compensation packages. Furthermore, the correlation between board size and firm size is positive. This is because larger firms tend to have larger boards of directors. Also, the correlation between GDP Growth and the COVID Crisis is coincidental since the dummy depends exclusively on the year.

According to Sharma (2005), multicollinearity is possible when the correlation value exceeds 0.8. However, the most significant correlation observed in the present study is 75%, suggesting that multicollinearity is not a significant concern. A Variance Inflation Factor (VIF) is typically used in regression analysis to assess multicollinearity. In this study, all VIF values were below 10, indicating that multicollinearity is not a severe issue.

b. Main findings: Baseline OLS cluster estimation

i. CEO power and firm tail risk: Baseline OLS cluster at firm level.

Using the Ordinary Least Squares (OLS) with clustered standard error at the firm level, the results for the baseline estimation model (eq. 3) are shown in Table 3. The relationship between CEO power and Expected Shortall (ES) is presented in columns 1-4, illustrating four variations. The first variation comprises only CEO power with the year, industry, and country dummy fixed effects. In the second model variation, other CEO characteristics are considered: age (CEO_Age), gender (CEO_fem), delta (Delta), tenure (CEO_Tenure), and education (CEO_Edu). The third model variation further controls for the compositions of boards and specific characteristics of firms, including board size (Board_size) and female directors on the board (%female), sales growth (Growth), firm size (SIZE), R&D expense (R&D%), profitability (Profit), asset tangibility (CAPEX), growth opportunity, surplus cash (Cash_surp), and a dividend cut (Div_cut). The last model variation contains all the previously outlined variables in Sections 5.b and 5.c.

The adjusted R-squared of all four models increases across all variations, and the maximum value is found for the last complete model (column 4), in which all other variables are included, where the R-squared is the highest. As a result, the findings are interpreted using this full model, whilst other model variations robustly check for the consistency of the findings across different sets of control variables. Furthermore, the two last columns (Columns 5-6) of Table 3 provide results for the full model regarding the relationships between CEO power and the two components of expected Shortfall (ES): idiosyncratic expected shortfall (ES-Idio) and systematic expected shortfall (ES-Sys), respectively.

As presented in Table 3, the coefficient β_1 of the CEO power variable (CPS) shows positive values of 0.119, 0.162, 0.095, and 0.095, which are consistent across the four model variations and statistically significant at 5% or less critical level (Columns 1-4, respectively). These results indicate a positive relationship between CEO power and tail risk, supporting Hypothesis 1. Regarding economic significance level, there is approximately a 10% increase in firm tail risk for every 1% rise in CEO power (as measured by a 1% increase in the CEO's salary relative to the total pay of the top five directors). This positive relationship can be explained by the fact that CEOs with more power tend to be more assured and upbeat about their decision-making while also overlooking and underestimating any potential negative consequences, as argued by the approach/inhibition theory of power (Keltner et al., 2003; Anderson & Galinsky, 2006).

With the decomposition of tail risk into idiosyncratic tail risk (ES-Idio) and systematic tail risk (ES-Sys), as revealed in Columns 5-6, the impacts of CEO power are found to be statistically significant on both tail risk that result from firm-specific factors and market-born factors. The economic significance of the effects on both types of tail risk is relatively similar, such that a 1% increase in CEO pay slice (CPS) leads to roughly 13% and 16% increase in firm-specific tail risk and market-based tail risk, respectively. Consequently, the CEO power relationship with the two tail risk components is economically significant.

CEOs with power make risk-related decisions that adhere to their power status, i.e., optimism and risk underestimation. This leads to riskier decisions (Sheikh, 2019), heightening the likelihood of aggressive risk-taking. Therefore, higher idiosyncratic risk is exposed. Regarding systematic tail risk, aggressive risk-taking can be conducted on overinvestment in value-damaging projects linked to the external market environment and conditions. Furthermore, compensation incentives to CEOs have become important corporate information that market participants are concerned about. CEOs with relatively higher compensation packages (higher CPS – higher power) may bring negative signals to the market regarding the firm agency cost and management. Building on that, the trust and confidence of the market participants can be shaken, and together with the high-to-extreme risk-seeking decisions of powerful CEOs, market turbulences can cause a firm's extreme stock loss.

Regarding control variables, firm tail risk is negatively impacted by CEO delta, CEO tenure, firm size, profitability, and dividend cut policy but positively influenced (increased) by firm leverage and during crises (financial and health crises). These impacts are supported by Yung and Chen (2018) and Sila et al. (2016).

Table 3: Influences of CEO power on firm tail risk – The baseline estimation model

Table 3 demonstrates the baseline methods (OLS) estimation results with clustered standard error at a firm level between 2006 and 2021. Columns 1-4 presents the expected shortfall (ES) as the dependent variable, column 5 presents the idiosyncratic expected shortfall (ES_idio), and column 6 presents the systemic expected shortfall (ES_Sys). ***CPS*** is defined as the total compensation of CEOs against the total compensation of the top-five executives in individual firm percentages. ***CEO-Age*** CEO's biological age in years. ***CEO-female*** as dummy representation, one if the CEO is a female and 0 if not. ***Delta*** is a natural logarithmic representation of CEOs' wealth change in dollar value for one parentage change in stock price. ***CEO_Tenure*** is the natural logarithm of the time spent as a firm CEO. ***CEO_Edu*** dummy representation of 1 if the CEO owns a master's or above degree, or 0 if not. Size firm total asset logarithmic representation. ***Growth*** sales annual growth rate percentage. ***Profit*** earnings before interest payments and income taxes to total assets ratio. R&D is the percentage of research and development expenses to total assets. ***Growth _oppo*** the ratio of Market-to-book. ***CAPEX*** is defined as the percentage of net fixed assets to total assets. ***Div_cut*** dummy representation of 1 if the annual dividend payout decreased and 0 if not. ***Board_size*** is the total number of directors on the firm's board. ***% Female,*** the division of female directors on board. ***Financial and COVID crisis*** dummy representation of 1 if the observation of firm-year fall between 2007 to 2009 and between 2020 to 2021, respectively, and 0 if not. ***GDP_growth*** calculates the GDP growth (economic growth) percentage of the countries. ***Inflation_rate*** annual change percentage in the countries' consumer price index (CPI). ***Foreign_Inv*** calculates the percentage of foreign direct investment in the countries' GDP. ***Trade (% of GDP)*** calculates the % of the country's trade of their GDP. Standard errors are in parentheses. *, **, and *** denote statistical significance levels at 10%, 5%, and 1%, respectively.

Variable	(1) ES	(2) ES	(3) ES	(4) ES	(5) ES-Idio	(6) ES-Sys
CPS	0.119***	0.162***	0.0953**	0.0950**	0.135***	0.163***
	(0.0311)	(0.0378)	(0.0398)	(0.0398)	(0.0495)	(0.0483)
CEO_Age		-	0.000721	0.000721	0.000332	0.000231
		(0.000450	(0.000621)	(0.000622)	(0.000820)	(0.000804)
CEO_ female		-	0.00338	0.00292	-0.00622	-0.00513
		(0.0102)	(0.0147)	(0.0147)	(0.0174)	(0.0163)
Delta		-	-0.0158***	-0.0157***	-0.0195***	-0.0203***
		(0.00355)	(0.00323)	(0.00322)	(0.00396)	(0.00374)
CEO_Tenure		-	-0.0175***	-0.0176***	-0.0219***	-0.0172***
		(0.00436)	(0.00543)	(0.00544)	(0.00678)	(0.00649)
CEO_Edu		0.00766	0.00856	0.00833	0.0139	0.0165*
		(0.00661)	(0.00814)	(0.00813)	(0.0104)	(0.00991)
SIZE			-0.0428***	-0.0427***	-0.0722***	-0.0500***
			(0.00426)	(0.00425)	(0.00583)	(0.00562)
Growth			-0.00240	-0.00233	-0.0174	-0.0246
			(0.0173)	(0.0173)	(0.0196)	(0.0170)
Profit			-0.195***	-0.194***	-0.240***	-0.214***
			(0.0355)	(0.0355)	(0.0414)	(0.0394)
R&D %			-0.00678	-0.00752	-0.0266	-0.0663
			(0.0740)	(0.0741)	(0.105)	(0.103)
Growth_oppo			-8.56e-06	1.19e-05	-0.00133**	-0.00126**
			(0.000498)	(0.000496)	(0.000599)	(0.000580)
CAPEX			-0.0126	-0.0132	-0.0377	-0.0477
			(0.0236)	(0.0236)	(0.0311)	(0.0310)
Leverage			0.251***	0.251***	0.266***	0.157**
			(0.0494)	(0.0494)	(0.0694)	(0.0679)
Cash_surp			-0.00775	-0.00744	-0.0930*	-0.121**
			(0.0374)	(0.0374)	(0.0533)	(0.0491)
Div_cut			-0.0232***	-0.0235***	-0.0635***	-0.0571***
			(0.00829)	(0.00861)	(0.0113)	(0.0107)
Board_size			0.000506	0.000507	0.000712	0.000677
			(0.00144)	(0.00143)	(0.00182)	(0.00178)
% Female			-0.151***	-0.152***	-0.169***	-0.139**
			(0.0467)	(0.0469)	(0.0637)	(0.0598)
Crisis_F			0.188***	0.280***	0.312***	0.326***
			(0.0165)	(0.0593)	(0.0648)	(0.0619)
Crisis_C			0.126***	0.208***	0.276***	0.270***
			(0.0289)	(0.0643)	(0.0718)	(0.0696)
GDP_ Growth				0.00776	0.00700	0.00826
				(0.00715)	(0.00770)	(0.00751)
Inflation_Rate				0.0138	0.0211**	0.0244**
				(0.00983)	(0.00985)	(0.00972)
Foreign_ Inv				0.00280	-0.000190	0.00230

				(0.00228)	(0.00266)	(0.00258)
Trade (% of GDP)				0.00402**	0.00681***	0.00625***
				(0.00193)	(0.00242)	(0.00241)
Constant	-1.705***	-1.368***	-0.930***	-1.253***	-0.949***	-1.696***
	(0.129)	(0.145)	(0.203)	(0.244)	(0.282)	(0.255)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed	Yes	Yes	Yes	Yes	Yes	Yes
Observations	34,597	27,397	12,761	12,761	12,607	12,612
R-squared	0.125	0.159	0.252	0.253	0.302	0.239
F-statistic	96.10	75.28	37.84	50.71	40.43	41.02

ii. Robustness Check: Alternative estimation models

Given that the cluster standard error can be a valuable tool in dealing with heteroskedasticity and autocorrelation in providing reliable and efficient standard errors, endogeneity issues need to be tackled, which can lead to biased and unreliable estimates. Stock and Watson (2003) describe endogeneity as correlated error terms with the independent variables caused by three main problems: measurement error, omitted variables, or simultaneity. We employ a few alternative models to deal with endogeneity: lagged approach, fixed/random effects, and the system General Method of Moment (GMM). In Table 4 (panel A), the results of the Hausman test are statistically significant at a 1% critical level, indicating the appropriate use of fixed effect rather than random effect. The lagged approach deals with the issues of reverse causality, fixed effect controls for time-invariant omitted variables, and the last model GMM tackles all three sources of endogeneity (Trinh, Aljughaiman, Cao, 2020; Ullah, Akhtar, and Zaefarian, 2018).

The results presented in Table 4 confirm the baseline findings. The fixed effect and lagged models show positive relationships between CEO power and all three tail risks. An increase in CEO power by 1% tends to increase the expected shortfall, idiosyncratic expected shortfall, and systematic expected shortfall by 12-13% for the fixed effect and 4-10% for the lagged approach. Regarding the two-step system GMM, as reported in Table 4 (panel C), there is a statistical significance in the first autocorrelation test for this model (p-value (AR1) < 0.1). Moreover, due to the robust option, the autocorrelation issue cannot be confirmed. Nevertheless, it has been shown that the second-order autocorrelation test (AR2) does not generate a significant result, conclusively ruling out the possibility of autocorrelation in our model. In addition, all models provide insignificant statistics according to the Hansen test for overidentification. Hence, it indicates the appropriateness of our employed instrumental variables.

In hypothesis testing, the coefficient of CPS (CEO power) shows a significant positive coefficient, as found in the baseline main findings. It demonstrates that increased CEO power results in increased firm tail risk. In detail, a 1% increase in CEO power results in an increase of almost 8.6% for the expected shortfall, 12.3% for the idiosyncratic expected shortfall, and 11.4% for the systematic expected shortfall. However, the result for idiosyncratic expected shortfall is slightly insignificant.

Table 4: Robustness check using alternative estimation models

Table 4 illustrates the results of the three different robustness check approaches with the consideration of the endogeneity problems: the Fixed effect model (Panel A), the lagged approach (Panel B) and GMM (Panel C). The dependent variables are expected shortfall (ES) presented in columns 1-4, and 7; idiosyncratic expected shortfall (ES_idio) presented in columns 2-5, and 8; and systematic expected shortfall (ES_Sys) presented in columns 3-6, and 9. ***ES*** refers to the negative value of the average firm's stock loss of the 5% worst returns annually, ***ES_Idio*** refers to the negative values of the average of the day-to-day residuals returns that are recorded as the 5th percentile of the yearly distribution, ***ES_Sys*** refers to the negative values of the average of the day-to-day predicted returns that are recorded as the 5th percentile of the annual). ***CPS*** is defined as the total compensation of CEOs against the total compensation of the top-five executives in individual firm percentages. ***CEO-Age*** CEO's biological age in years. ***CEO-female*** as dummy representation, one if the CEO is a female and 0 if not. ***Delta*** is a natural logarithmic representation of CEOs' wealth change in dollar value for one parentage change in stock price. ***CEO_Tenure*** is the natural logarithm of the time spent as a firm CEO. ***CEO_Edu*** dummy representation of 1 if the CEO owns a master's or above degree, or 0 if not. Size firm total asset logarithmic representation. ***Growth*** sales annual growth rate percentage. ***Profit*** earnings before interest payments and income taxes to total assets ratio. R&D is the percentage of research and development expenses to total assets. ***Growth _oppo*** the ratio of Market-to-book. ***CAPEX*** is defined as the percentage of net fixed assets in total assets. ***Div_cut*** dummy representation of 1 if the annual dividend payout decreased and 0 if not. ***Board_size*** is the total number of directors on the firm's board. ***% Female,*** the division of female directors on board. ***Financial and COVID crisis*** dummy representation of 1 if the observation of firm-year fall between 2007 to 2009 and between 2020 to 2021, respectively, and 0 if not**.** ***GDP_growth*** calculates the GDP growth (economic growth) percentage of the countries. ***Inflation_rate*** annual change percentage in the countries' consumer price index (CPI). ***Foreign_Inv*** calculates the percentage of foreign direct investment in the countries' GDP. ***Trade (% of GDP)*** calculates the % of the country's trade of their GDP. Standard errors are in parentheses. *, **, and *** denote statistical significance levels at 10%, 5%, and 1%, respectively.

	Panel A: Fixed Effect			Panel B: Lagged Approach			Panel C: GMM		
Variable	**(1) ES**	**(2) ES-Idio**	**(3) ES-Sys**	**(4) ES**	**(5) ES-Idio**	**(6) ES-Sys**	**(7) ES**	**(8) ES-Idio**	**(9) ES-Sys**
L1	-	-	-	-	-	-	0.252***	0.704***	0.272***
	-	-	-	-	-	-	(0.0842)	(0.232)	(0.0873)
CPS	0.137***	0.120**	0.125***	0.0385*	0.0830*	0.106**	0.0864**	0.123	0.114***
	(0.0450)	(0.0499)	(0.0466)	(0.0232)	(0.0468)	(0.0459)	(0.0403)	(0.0777)	(0.0419)
CEO Age	0.00205**	0.00151*	0.00129*	-0.000303	-9.18e-05	-6.72e-05	0.000912	-8.19e-05	-0.000231
	(0.000647	(0.00073	(0.00070	(0.000442)	(0.000756	(0.000732)	(0.000661)	(0.00146)	(0.000731)
CEO female	0.00760	-0.0116	-0.00487	-0.00424	0.0104	0.0135	0.00897	-0.0331	-0.0143
	(0.0162)	(0.0158)	(0.0140)	(0.00987)	(0.0191)	(0.0192)	(0.0117)	(0.0364)	(0.0129)
Delta	-0.0147***	-0.0168***	-0.0159***	-0.00791***	-0.0145***	-0.0142***	-0.0108	-0.0175***	-0.0220**
	(0.00312)	(0.00361)	(0.00333	(0.00287)	(0.00380)	(0.00351)	(0.00961)	(0.00658)	(0.0108)
CEO Tenure	-0.0112*	-0.0122**	-0.00870	-0.00427	-0.0124*	-0.00987	-0.00671	-0.00532	-0.00365
	(0.00583)	(0.00597)	(0.00570	(0.00353)	(0.00695)	(0.00657)	(0.00598)	(0.0104)	(0.00643)
CEO Edu	0.00236	0.00258	0.00366	0.00577	0.0127	0.0139	-0.0146	0.109	0.0321
	(0.00949)	(0.0103)	(0.00938	(0.00533)	(0.0102)	(0.00991)	(0.0321)	(0.345)	(0.0322)
SIZE	-0.0441***	-0.0817***	-0.0761***	-0.0168***	-0.0680***	-0.0464***	-0.0220***	-0.0184	-0.0161***
	(0.0126)	(0.0151)	(0.0143)	(0.00266)	(0.00530)	(0.00504)	(0.00467)	(0.0200)	(0.00534)
Growth	-0.0248	-0.0418**	-0.0433***	-0.0101	-0.00705	-0.00521	0.000896	-0.0254	-0.00948
	(0.0151)	(0.0167)	(0.0155)	(0.0151)	(0.0212)	(0.0191)	(0.0132)	(0.0199)	(0.0120)
Profit	-0.130***	-0.0655	-0.0257	-0.141***	-0.324***	-0.287***	-0.186***	-0.148***	-0.199***
	(0.0347)	(0.0438)	(0.0425)	(0.0305)	(0.0457)	(0.0433)	(0.0327)	(0.0481)	(0.0356)
R&D %	-0.203*	-0.229*	-0.258**	-0.0126	0.00316	-0.0635	-0.0245	-0.0259	-0.0270

	(0.110)	(0.120)	(0.109)	(0.0592)	(0.113)	(0.122)	(0.0605)	(0.0707)	(0.0693)
Growth oppo	0.000360	-0.00116	-0.00117*	0.00115	1.79e-05	0.000128	0.000123	0.000485	0.000105
	(0.000640	(0.00071	(0.00066	(0.00128)	(0.000768	(0.000717)	(0.000384)	(0.000801)	(0.000444)
CAPEX	-0.0403	-0.0391	-0.0281	0.00243	-0.00675	-0.0235	-0.00998	0.00362	-0.0361
	(0.0324)	(0.0370)	(0.0333)	(0.0164)	(0.0331)	(0.0330)	(0.0164)	(0.0256)	(0.0247)
Leverage	0.374***	0.519***	0.420***	0.0280	0.217***	0.111	0.179***	0.133**	0.0567
	(0.0709)	(0.0890)	(0.0815)	(0.0384)	(0.0703)	(0.0679)	(0.0400)	(0.0592)	(0.0437)
Cash surp	-0.132**	-0.238***	-0.264***	-0.0738***	-0.139***	-0.141***	0.0372	-0.0747	-0.0350
	(0.0564)	(0.0632)	(0.0664)	(0.0278)	(0.0517)	(0.0498)	(0.0253)	(0.0566)	(0.0292)
Div cut	0.00696	-0.0153*	-0.0178**	-0.0187***	-0.0571***	-0.0527***	-0.00541	-0.0204	-0.0214***
	(0.00687)	(0.00805)	(0.00768	(0.00631)	(0.0114)	(0.0107)	(0.00602)	(0.0146)	(0.00782)
Board size	-0.00119	-0.00493***	-0.00403**	0.000652	0.00136	0.000773	0.000604	0.00111	0.000289
	(0.00116)	(0.00175)	(0.00161	(0.000883)	(0.00175)	(0.00169)	(0.00102)	(0.00239)	(0.00127)
% Female	-0.232***	-0.326***	-0.294***	-0.0810***	-0.167***	-0.115**	-0.0348	-0.149*	-0.0281
	(0.0504)	(0.0698)	(0.0609)	(0.0302)	(0.0598)	(0.0567)	(0.0493)	(0.0886)	(0.0559)
Crisis F	0.256***	0.304***	0.321***	0.0148	0.196***	0.202***	-	-	-
	(0.0497)	(0.0542)	(0.0516)	(0.0318)	(0.0436)	(0.0396)	-	-	-
Crisis C	0.236***	0.344***	0.350***	-0.0225	0.124*	0.114*	-	-	-
	(0.0561)	(0.0621)	(0.0610)	(0.0576)	(0.0741)	(0.0643)	-	-	-
GDP Growth	0.00724	0.00882	0.00989*	-0.00573	-0.00212	-0.000618	0.00494	0.00272	0.00393**
	(0.00573)	(0.00611)	(0.00600)	(0.00621)	(0.00771)	(0.00663)	(0.00496)	(0.00335)	(0.00153)
Inflation Rate	0.00767	0.0193**	0.0216**	-0.00913	-0.00289	0.00333	0.00499	0.00258	0.00219
	(0.00791)	(0.00806)	(0.00778	(0.00751)	(0.00981)	(0.00873)	(0.00720)	(0.00254)	(0.00154)
Foreign Inv	0.00426**	0.000228	0.00313	0.00101	-0.00152	-0.00111	0.00331**	-0.421	-1.445***
	(0.00215)	(0.00247)	(0.00238	(0.00162)	(0.00221)	(0.00212)	(0.00135)	(0.276)	(0.276)
Trade (% of GDP)	0.00541**	0.0103**	0.00907*	0.00153	0.00131	0.000227	0.00309**	0.704***	0.272***
	(0.00175)	(0.00223)	(0.00217	(0.00151)	(0.00235)	(0.00230)	(0.00136)	(0.232)	(0.0873)
Constant	-1.667***	-1.294***	-1.478***	0.561***	-0.585**	-1.272***	-1.280***	0.123	0.114***
	(0.189)	(0.233)	(0.220)	(0.198)	(0.280)	(0.257)	(0.291)	(0.0777)	(0.0419)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	NO	NO	NO	Yes	Yes	Yes	Yes	Yes	Yes
country fixed effect	NO	NO	NO	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,761	12,607	12,612	13,222	13,064	13,065	12,604	12,440	12,454
R-squared	0.1849	0.2029	0.1547	0.095	0.300	0.235	-	-	-
F-statistic	69.50	45.83	50.99	7.37	26.77	26.96	-	-	-
Hausman test (Chi-square)	126.76***	231.45***	241.07***	-	-	-	-	-	-
AR (1) p_value	-	-	-	-	-	-	0.000	0.000	0.194
AR (2) p_value	-	-	-	-	-	-	0.305	0.963	0.944
Hansen-test (p_value)	-	-	-	-	-	-	0.618	0.923	0.366

iii. The 2-stage least square (2SLS) approach

In addition, to deal with the three sources of endogeneity, we conduct the 2-stage least square (2SLS) approach (or instrumental model) (Trinh, Cao, and Elnahass, 2023). We employ two instrumental variables: the median of CEO power (CPS) at both country and industry levels and CEO retirements (Fan, Boateng, and Jiang, 2021; Chintrakarn, Jiraporn, and Tong, 2015). An instrumental variable (IV) needs to meet two crucial criteria. First, it should be exogenous. Second, it should have a significant relationship with the explanatory variable of interest, in this case, the CEO power (CPS). The reason for employing the median CPS of CEOs from previous studies is that it is likely to be positively associated with the CPS of the firm. This is because, within the same industry of the same country, similar criteria for appointing CEOs and comparable relative compensation for CEOs are applied. At the same time, the median CPS is not directly influenced by firm-specific characteristics, making it exogenous. Additionally, we use CEO retirements as another instrumental variable. This variable indicates whether the CEO is within two years of retirement or beyond retirement age. It is considered exogenous because it is primarily determined by the country's retirement laws and the CEO's biological age. We predict that this variable is positively related to CEO power, as CEOs with more experience and knowledge are likely to have higher power as retirement approaches.

The results in Table 5 of our regression analysis show the impact of CEO power on firm tail risk using the 2SLS estimator. In the first stage, we regress CEO power on the two instrumental variables (retirement and CPS_med). As expected, the coefficients for CPS_med and CEO retirements were positive, but the latter was not statistically significant. The Hansen overidentification test is statistically insignificant, confirming the validity and appropriateness of the instrumental variables and, hence, reinforcing their integrity and effectiveness in addressing endogeneity concerns (Albarrak, Elnahass, and Salama, 2019).

In the second stage, we regress firm tail risk variables using the fitted values obtained from the first-stage regressions. All the results consistently indicate a positive and significant relationship between CEO power and firm tail risk, with statistical significance at or below the 1% level. These findings are robust across all models and confirm the validity of our chosen instrumental variables while also highlighting the presence of endogeneity issues. In conclusion, our main results demonstrate a robust positive link between CEO power and firm tail risk, supporting our research.

Table 5: Robustness check using alternative estimation model (2SLS)

Table 5 presents the results of the 2SLS approach from 2006 through 2021. The dependent variables are expected shortfall (ES) presented in columns 1, idiosyncratic expected shortfall (ES_idio) presented in columns 2, and systematic expected shortfall (ES_Sys) presented in columns 3. ***ES*** refers to the negative value of the average firm's stock loss of the 5% worst returns annually, ***ES_Idio*** refers to the negative values of the average of the day-to-day residuals returns that are recorded as the 5th percentile of the yearly distribution, ***ES_Sys*** refers to the negative values of the average of the day-to-day predicted returns that are recorded as the 5th percentile of the yearly). **CPS** captures the percentage of the CEO's total compensation to the total compensation of the top five executives in each firm. ***CEO_Age*** biological age of the CEO (in years). ***CEO_ female*** denotes one if the CEO is female and 0 otherwise. ***Delta is*** the natural logarithm of the change in dollar value of CEOs' wealth for a one percentage point change in stock price. ***CEO_Tenure*** is the natural logarithm of the number of years the CEO has held the position. ***CEO_Edu*** 1 if the CEO has a master's degree or above or 0 otherwise. ***Size*** refers to the logarithm of the firm total assets. ***Growth*** captures % annual growth rate in sales. ***Profit is*** the ratio of earnings before interest payments and income taxes to total assets. ***R&D%*** research and development expenses to total assets. ***Growth_oppo*** Market-to-book ratio. ***CAPEX*** captures % of net fixed assets to total assets. ***Div_cut*** dummy one if there is a reduction in annual dividend payout and 0 otherwise. ***Board_size*** is the number of directors on the firm board of directors. ***% Female*** the fraction of female directors on board. ***Financial and Covid crisis*** one if the firm-year observations fall in 2007-2009 and 2020-2021, respectively, and 0 otherwise. ***GDP_growth*** measures the countries' % GDP growth (economic growth), and Inflation_rate is the % annual change in the countries' consumer price index (CPI). ***Foreign_Inv*** measures the % of foreign direct investment in the GDP of the nations, ***Trade (% of GDP)*** measures the percentage of the countries' trade of their GDP, ***Retirements*** 1 if the company has CEO's time to retirement is less than or equal to 2, and ***CPS_med is the*** median of value of CPS across each industry in each country. Standard errors are in parentheses. *, **, and *** denote statistical significance levels at 10%, 5%, and 1%, respectively.

	2SLS		
Variable	**(1) ES**	**(2) ES-Idio**	**(3) ES-Sys**
First Stage			
Retirements		.0037816 (0.415)	
CPS_med		1.032663*** (0.000)	
Second Stage			
CPS	0.5358*** (0.000)	0.6134*** (0.000)	0.7199*** (0.000)
Constant	-1.4695*** (0.000)	-0.9562*** (0.000)	-1.5835*** (0.000)
Controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
Chi_sq (p-value)	0.0000	0.0000	0.0000
F-test (p-value)	0.0000	0.0000	0.0000
Hansen overidentification (p-value)	0.4704	0.3035	0.7849
Observations	15663	15475	15483
R-squared	0.2308	0.2813	0.2087

iv. Robustness Check: Alternative dependent variables

To further ensure the findings, we employ two additional tail risk measures. These are the marginal expected shortfall (MES) and the value at risk (VaRisk) (Bushman, Davidson, Dey, and Smith, 2018; Bekkum, 2016; Trinh, Cao, and Elnahass, 2023; Milidonis, Nishikawa, and Shim, 2019). The MES is the average return for a firm's stocks during the 5% worst return days for the market annually. Additionally, following Trinh, Cao, and Elnahass (2023) and Milidonis, Nishikawa, and Shim (2019), the VaRISK measure was processed as the stock return negative value at a 95% confidence level for each firm annually. The results in Table 6 confirm that CEO power is positively associated with firm tail risk. It has been concluded that there is an increase of about 13.3% and 3.16 % of tail risk measured by MES and VaRISK, respectively, for every 1% rise in CEO power. Generally, this robustness test indicates that firms with CEOs with more power tend to be exposed to higher tail risk using all measures.

Table 6: Robustness check using alternative dependent variables

Table 6 demonstrates the results of the two different robustness check measures of firm tai risk clustered standard error at the firm level. These are ***MES*** (column 1) measured by the average return for a firm's stocks during the 5% worst return days for the market during a year. ***VaRISK*** (column 2) is the negative value of the stock return at a 95% confidence level for every single firm annually. ***CPS*** is defined as the total compensation of CEOs against the total compensation of the top-five executives in individual firm percentages. ***CEO-Age*** CEO's biological age in years. ***CEO-female*** as dummy representation, one if the CEO is a female and 0 if not. ***Delta*** is a natural logarithmic representation of CEOs' wealth change in dollar value for one parentage change in stock price. ***CEO_Tenure*** defined as the natural logarithm of the time spent as a CEO of the firm. ***CEO_Edu*** dummy representation of 1if the CEO owns a master's or above degree, or 0 if not. Size firm total asset logarithmic representation. ***Growth*** sales annual growth rate percentage. ***Profit*** earnings before interest payments and income taxes to total assets ratio. R&D the percentage of research and development expenses to total assets. ***Growth _oppo*** the ratio of Market-to-book. ***CAPEX*** is defined as the percentage of net fixed assets to total assets. ***Div_cut*** dummy representation of 1 if the annual dividend payout decreased and 0 if not. ***Board_size*** is the total number of directors on the firm's board. ***% Female,*** the division of female directors on board. ***Financial and COVID crisis*** dummy representation of 1 if the observation of firm-year fall between 2007 to 2009 and between 2020 to 2021, respectively, and 0 if not**.** ***GDP_growth*** calculates the GDP growth (economic growth) percentage of the countries. ***Inflation_rate*** annual change percentage in the countries' consumer price index (CPI). ***Foreign_Inv*** calculates the percentage of foreign direct investment in the countries' GDP. ***Trade (% of GDP)*** calculates the % of the country's trade of their GDP. Standard errors are in parentheses. *, **, and *** denote statistical significance levels at 10%, 5%, and 1%, respectively.

Variable	(1) MES	(2) VaRISK
CPS	0.133***	0.0316*
	(0.0343)	(0.0173)
CEO_Age	-2.86e-06	0.000384
	(0.000532)	(0.000244)
CEO_female	-0.00329	0.00525
	(0.0119)	(0.00539)
Delta	-0.0140***	-0.00965***
	(0.00215)	(0.00136)
CEO_Tenure	-0.0131***	-0.00800***
	(0.00437)	(0.00207)
CEO_Edu	0.0129*	-0.000642
	(0.00658)	(0.00318)
SIZE	-0.0599***	-0.0131***
	(0.00266)	(0.00117)
Growth	-0.0304**	0.00380
	(0.0141)	(0.00824)
Profit	-0.200***	-0.108***
	(0.0264)	(0.0179)
R&D %	-0.117**	-0.00253
	(0.0554)	(0.0321)
Growth_oppo	-0.00140***	0.000311
	(0.000472)	(0.000261)
CAPEX	-0.0587***	0.00810
	(0.0179)	(0.0109)
Leverage	0.108***	0.165***
	(0.0384)	(0.0235)
Cash_surp	-0.146***	0.0359***
	(0.0250)	(0.0121)
Div_cut	-0.0579***	-0.00137
	(0.00730)	(0.00383)
Board_size	0.00126	-0.000267
	(0.000943)	(0.000498)
% Female	-0.109***	-0.105***
	(0.0332)	(0.0164)
Crisis_F	0.325***	0.145***
	(0.0615)	(0.0367)
Crisis_C	0.241***	0.104***
	(0.0694)	(0.0395)
GDP_Growth	0.00464	0.00315
	(0.00756)	(0.00465)
Inflation_Rate	0.0138	0.000908
	(0.0104)	(0.00693)
Foreign_Inv	0.00487**	0.000193
	(0.00246)	(0.00135)
Trade (% of GDP)	0.00293	0.00299***
	(0.00179)	(0.000886)
Constant	-1.223***	-1.822***

	(0.157)	(0.0817)
Year fixed effect	Yes	Yes
Industry fixed effect	Yes	Yes
Country fixed effect	Yes	Yes
Observations	12,567	12,761
R-squared	0.321	0.270
F-statistic	97.14	95.96

v. Robustness Check: Alternative independent variables

Following extant studies, alternative proxies of CEO power are also employed as robustness checks: CEO power index, CEO duality, and board independence. The following is an explanation of how they computed:

1- Three dummy proxy measures are taken into account in this study to construct the CEO power index. They are the CEO pay slice (Cpower_D), CEO duality, and board independence. When the firm's independent directors are less than the sample median, the board independence dummy is one; otherwise, it is zero. Since board effectiveness is a determinant of CEO power, lower board independence is associated with higher CEO power. In addition, Cpower_D is a dummy variable with the value one when the CEO pay slice (CPS) is higher than the median value in the sample and zero otherwise. As a dummy variable, CEO duality equals one if the company's CEO and chairperson is the same; if not, it's zero. So, when we add the three dummies together. The CEO power index has three possible values: 0, 1, 2, and 3. High indexes indicate more power for CEOs.
2- CEO duality (CEO_DUAL): If one person holds the firm's CEO and Chairman, then the dummy variable is one; otherwise, it is zero (Lewellyn & Muller-Kahle 2012).
3- Board independence (Board_INDEP_%): the percentage of outside directors not affiliated with a firm (Lewellyn and Muller-Kahle, 2012). The calculation is as follows:

$$Board\_INDEP(\%) = \frac{Number\ of\ independent\ board\ directors}{Board\ size} \qquad (7)$$

The obtained results of the three alternative measures of CEO power can be found in Table 7: CEO duality (Panel A), board independence (Panel B), and CEO power index (Panel C). Confirming the main findings, firms led by a powerful CEO (proxied by a dual CEO-chairman) encounter higher tail risk by 2.5% than firms led by non-powerful CEOs. This has statistical significance at a 1% level or lower. In Panel B, board independence is a reverse proxy for CEO power, such that higher values indicate less power for CEOs. This is because boards with more outside directors impose more monitoring to serve shareholders' interests (Lewellyn and

Muller-Kahle, 2012). Table 7 (Panel B) shows that the negative coefficients of board-independent variables across the three tail risk types support the main findings, yet the estimates are not statistically significant.

Lastly, as revealed in Panel C, using a CEO power index to measure CEO power also indicates that more powerful CEOs lead to higher tail risk. Significant results are found for all three types of tail risk. Particularly, one unit increase in CEO power will lead to a 1.9% higher total tail risk, 2.5% higher idiosyncratic tail risk, and 2.1% higher systematic tail risk. To conclude, the results of all robustness tests thus far support Hypothesis 1.

Table 7: Robustness check using alternative independent variables

Table 7 demonstrates the results of the two different robustness check measures of CEO power with clustered standard error at the firm level. These are CEO duality (Panel A), board independence (Panel B), and CEO power index (Panel C). CEO power index takes an ordinal value ranging from zero to three; it is the summation of three dummy variables proxied for CEO power, i.e., CEO duality dummy + CEO pay slice dummy + Board independence dummy. The dependent variables are expected shortfall (ES) presented in columns 1-4, and 7; idiosyncratic expected shortfall (ES_idio) presented in columns 2-5, and 8; and systematic expected shortfall (ES_Sys) presented in columns 3-6, and 9. ***ES*** refers to the negative value of the average firm's stock loss of the 5% worst returns annually, ***ES_Idio*** refers to the negative values of the average of the day-to-day residuals returns that are recorded as the 5th percentile of the yearly distribution, ***ES_Sys*** refers to the negative values of the average of the day-to-day predicted returns that are recorded as the 5th percentile of the yearly). ***CPS*** is defined as the total compensation of CEOs against the total compensation of the top-five executives in individual firm percentages. ***CEO-Age*** CEO's biological age in years. ***CEO-female*** as dummy representation, one if the CEO is a female and 0 if not. ***Delta*** is a natural logarithmic representation of CEOs' wealth change in dollar value for one parentage change in stock price. ***CEO_Tenure*** is the natural logarithm of the time spent as a firm CEO. ***CEO_Edu*** dummy representation of 1 if the CEO owns a master's or above degree, or 0 if not. Size firm total asset logarithmic representation. ***Growth*** sales annual growth rate percentage. ***Profit*** earnings before interest payments and income taxes to total assets ratio. R&D is the percentage of research and development expenses to total assets. ***Growth _oppo*** the ratio of Market-to-book. ***CAPEX*** is defined as the percentage of net fixed assets to total assets. ***Div_cut*** dummy representation of 1 if the annual dividend payout decreased and 0 if not. ***Board_size*** is the total number of directors on the firm's board. ***% Female,*** the division of female directors on board. ***Financial and COVID crisis*** dummy representation of 1 if the observation of firm-year fall between 2007 to 2009 and between 2020 to 2021, respectively, and 0 if not**.** ***GDP_growth*** calculates the GDP growth (economic growth) percentage of the countries. ***Inflation_rate*** annual change percentage in the countries' consumer price index (CPI). ***Foreign_Inv*** calculates the percentage of foreign direct investment in the countries' GDP. ***Trade (% of GDP)*** calculates the % of the country's trade of their GDP. Standard errors are in parentheses. *, **, and *** denote statistical significance levels at 10%, 5%, and 1%, respectively.

Variable	Panel A: CEO duality			Panel B: Board independence			Panel C: CEO power index		
	(1) ES	(2) ES-Idio	(3) ES-Sys	(4) ES	(5) ES-Idio	(6) ES-Sys	(7) ES	(8) ES-Idio	(9) ES-Sys
CEO_duality	0.0259***	0.0373***	0.0325***	-	-	-	-	-	-
	(0.00929)	(0.0116)	(0.0111)	-	-	-	-	-	-
Brd_indep	-	-	-	-0.0104	-0.0546	-0.0504	-	-	-
	-	-	-	(0.0390)	(0.0520)	(0.0500)	-	-	-
CEO_power index	-	-	-	-	-	-	0.0186***	0.0248***	0.0212***
	-	-	-	-	-	-	(0.00530)	(0.00679)	(0.00642)
CEO_Age	-0.000174	-0.000733	-0.000781	0.000231	-0.000119	-0.000242	0.000361	-0.000176	-0.000344
	(0.000633)	(0.000854)	(0.000836)	(0.000619)	(0.000808)	(0.000793)	(0.000613)	(0.000813)	(0.000794)
CEO_ female	0.0102	0.00276	0.00291	0.00641	-0.00261	-0.00177	0.00457	-0.00412	-0.00409
	(0.0149)	(0.0176)	(0.0166)	(0.0149)	(0.0176)	(0.0166)	(0.0147)	(0.0175)	(0.0164)
Delta	-0.0155***	-0.0192***	-0.0191***	-0.0142***	-0.0177***	-0.0179***	-0.0163***	-0.0202***	-0.0201***
	(0.00335)	(0.00403)	(0.00377)	(0.00323)	(0.00388)	(0.00361)	(0.00330)	(0.00403)	(0.00377)
CEO_Tenure	-0.0159***	-0.0193***	-0.0139**	-0.0159***	-0.0194***	-0.0139**	-0.0174***	-0.0216***	-0.0162**
	(0.00540)	(0.00676)	(0.00653)	(0.00540)	(0.00677)	(0.00654)	(0.00541)	(0.00675)	(0.00651)
CEO_Edu	0.00940	0.0147	0.0173*	0.00943	0.0155	0.0180*	0.00923	0.0152	0.0177*
	(0.00811)	(0.0103)	(0.00987)	(0.00816)	(0.0103)	(0.00987)	(0.00809)	(0.0103)	(0.00984)
SIZE	-0.0429***	-0.0727***	-0.0512***	-0.0430***	-0.0712***	-0.0498***	-0.0415***	-0.0706***	-0.0490***
	(0.00423)	(0.00579)	(0.00560)	(0.00455)	(0.00612)	(0.00585)	(0.00430)	(0.00587)	(0.00566)
Growth	-0.00827	-0.0235	-0.0314*	-0.00859	-0.0247	-0.0325*	-0.00336	-0.0189	-0.0262
	(0.0173)	(0.0197)	(0.0171)	(0.0172)	(0.0196)	(0.0170)	(0.0173)	(0.0197)	(0.0171)

Profit	-0.195***	-0.244***	-0.219***	-0.196***	-0.245***	-0.220***	-0.196***	-0.242***	-0.216***
	(0.0353)	(0.0412)	(0.0395)	(0.0353)	(0.0413)	(0.0396)	(0.0355)	(0.0414)	(0.0395)
R&D %	-0.00262	-0.0295	-0.0697	-0.00434	-0.0306	-0.0705	-0.00526	-0.0237	-0.0640
	(0.0745)	(0.106)	(0.105)	(0.0751)	(0.107)	(0.106)	(0.0748)	(0.107)	(0.105)
Growth_oppo	0.000433	-0.000991	-0.000898	0.000450	-0.000924	-0.000836	3.47e-05	-0.00131**	-0.00126**
	(0.000553)	(0.000637)	(0.000629)	(0.000559)	(0.000640)	(0.000633)	(0.000496)	(0.000599)	(0.000582)
CAPEX	-0.0113	-0.0368	-0.0469	-0.0113	-0.0370	-0.0471	-0.0138	-0.0385	-0.0482
	(0.0236)	(0.0310)	(0.0310)	(0.0236)	(0.0308)	(0.0308)	(0.0236)	(0.0310)	(0.0310)
Leverage	0.270***	0.278***	0.170**	0.270***	0.278***	0.170**	0.252***	0.268***	0.162**
	(0.0497)	(0.0694)	(0.0683)	(0.0498)	(0.0695)	(0.0683)	(0.0494)	(0.0696)	(0.0682)
Cash_surp	-0.00304	-0.0911*	-0.123**	-0.00640	-0.0928*	-0.125***	-0.00522	-0.0905*	-0.120**
	(0.0369)	(0.0527)	(0.0486)	(0.0370)	(0.0527)	(0.0483)	(0.0374)	(0.0533)	(0.0492)
Div_cut	-0.0235***	-0.0637***	-0.0568***	-0.0238***	-0.0637***	-0.0568***	-0.0227***	-0.0625***	-0.0561***
	(0.00858)	(0.0113)	(0.0107)	(0.00860)	(0.0114)	(0.0107)	(0.00860)	(0.0113)	(0.0107)
Board_size	0.000238	0.000395	0.000265	4.81e-05	-2.68e-05	-0.000114	0.000448	0.000544	0.000341
	(0.00145)	(0.00185)	(0.00181)	(0.00148)	(0.00187)	(0.00183)	(0.00144)	(0.00184)	(0.00180)
% Female	-0.159***	-0.181***	-0.148**	-0.148***	-0.162**	-0.131**	-0.149***	-0.164***	-0.134**
	(0.0470)	(0.0636)	(0.0597)	(0.0467)	(0.0636)	(0.0600)	(0.0468)	(0.0636)	(0.0598)
Crisis_F	0.265***	0.301***	0.313***	0.267***	0.306***	0.318***	0.278***	0.308***	0.321***
	(0.0596)	(0.0649)	(0.0619)	(0.0598)	(0.0651)	(0.0623)	(0.0593)	(0.0645)	(0.0616)
Crisis_C	0.192***	0.266***	0.257***	0.192***	0.268***	0.259***	0.209***	0.277***	0.268***
	(0.0646)	(0.0716)	(0.0695)	(0.0646)	(0.0717)	(0.0696)	(0.0644)	(0.0717)	(0.0695)
GDP_ Growth	0.00680	0.00663	0.00768	0.00678	0.00649	0.00754	0.00744	0.00652	0.00768
	(0.00716)	(0.00768)	(0.00747)	(0.00717)	(0.00769)	(0.00748)	(0.00715)	(0.00768)	(0.00747)
Inflation_Rate	0.0122	0.0200**	0.0229**	0.0128	0.0213**	0.0241**	0.0132	0.0202**	0.0235**
	(0.00980)	(0.00981)	(0.00965)	(0.00979)	(0.00980)	(0.00966)	(0.00983)	(0.00983)	(0.00967)
Foreign_ Inv	0.00323	-1.32e-06	0.00246	0.00320	-1.45e-05	0.00246	0.00287	-9.52e-05	0.00237
	(0.00229)	(0.00267)	(0.00259)	(0.00230)	(0.00267)	(0.00259)	(0.00227)	(0.00266)	(0.00257)
Trade (% of GDP)	0.00365*	0.00646***	0.00597**	0.00401**	0.00734***	0.00676***	0.00406**	0.00687***	0.00637***
	(0.00194)	(0.00242)	(0.00240)	(0.00199)	(0.00246)	(0.00246)	(0.00193)	(0.00242)	(0.00241)
Constant	-1.139***	-0.812***	-1.547***	-1.179***	-0.892***	-1.619***	-1.248***	-0.938***	-1.661***
	(0.245)	(0.280)	(0.253)	(0.247)	(0.283)	(0.256)	(0.241)	(0.278)	(0.252)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,833	12,679	12,684	12,833	12,679	12,684	12,761	12,607	12,612
R-squared	0.251	0.301	0.239	0.250	0.301	0.238	0.253	0.302	0.238
F-statistic	51.67	41.31	41.20	51.37	41.22	41.12	51.60	40.94	41.02

c. *CEO power and firm tail risk in financial and health crises*

i. *Sub-sample approach*

A subsampling approach is employed to examine how CEO power and firm tail risk differ across crises (including financial versus non-financial crises and COVID-19 versus non-COVID-19 crises). Baseline analyses are conducted on four different sub-samples: financial crisis, non-financial crisis, COVID-19 crisis, and non-COVID-19 crisis. The obtained coefficients in each model will be statistically compared using Chow's test.

The results in Table 8 indicate that the obtained significant positive CEO power-tail risk relationship is mainly driven by the non-crisis periods: non-financial and non-covid crises. Particularly, it shows that a 1% increase in CEO power will lead to a rise of 10% in total tail risk during both the non-financial and non-covid crises, and the significant confidence level is 95%. The CEO power factor has lost its impact on tail risk during the turbulent economic and financial market times. Overall, the CEO power-tail risk relationship is different across financial (and health) crises and non-financial (-health) crises as indicated by the significant Chow's test (Chow's F-test = 11.22 and 5.52, respectively, p-value = 0.01).

According to this sub-sampling approach, Hypothesis 2 is supported. The effect attained only during the crises can be explained such that CEOs are likely to become more cautious with their risk decisions during turbulence due to all the uncertainty surrounding them. Thus, during crises, the tendency of CEOs with more power to be optimistic, overconfident, and risk underestimation is mitigated, and their risk-related decisions are reached with more caution and conservatism.

Table 8: CEO power and firm tail risk across financial and health crises – Sub-sample regressions

Table 8 demonstrates the results from the conducted sub-samples, along (with Chow's test) methods of the relationship between CEO power and firm tail risk during financial, non-financial, and COVID non-COVID crises. The dependent variable is ***ES, which*** refers to the negative value of the average firm's stock loss of the 5% worst returns annually. ***CPS*** is defined as the total compensation of CEOs against the total compensation of the top-five executives in individual firm percentages. ***CEO-Age*** CEO's biological age in years. ***CEO-female*** as dummy representation, one if the CEO is a female and 0 if not. ***Delta*** is a natural logarithmic representation of CEOs' wealth change in dollar value for one parentage change in stock price. ***CEO_Tenure*** is the natural logarithm of the time spent as a firm CEO. ***CEO_Edu*** dummy representation of 1 if the CEO owns a master's or above degree, or 0 if not. Size firm total asset logarithmic representation. ***Growth*** sales annual growth rate percentage. ***Profit*** earnings before interest payments and income taxes to total assets ratio. R&D is the percentage of research and development expenses to total assets. ***Growth _oppo*** the ratio of Market-to-book. ***CAPEX*** is defined as the percentage of net fixed assets to total assets. ***Div_cut*** dummy representation of 1 if the annual dividend payout decreased and 0 if not. ***Board_size*** is the total number of directors on the firm's board. ***% Female,*** the division of female directors on board. ***Financial and COVID crisis*** dummy representation of 1 if the observation of firm-year fall between 2007 to 2009 and between 2020 to 2021, respectively, and 0 if not**.** ***GDP_growth*** calculates the GDP growth (economic growth) percentage of the countries. ***Inflation_rate*** annual change percentage in the countries' consumer price index (CPI). ***Foreign_Inv*** calculates the percentage of foreign direct investment in the countries' GDP. ***Trade (% of GDP)*** calculates the % of the country's trade of their GDP. Standard errors are in parentheses. *, **, and *** denote statistical significance levels at 10%, 5%, and 1%, respectively.

Financial Crisis Vs Non-financial Crisis and Covid Vs non-covid crisis

Variable	(1) Financial Crisis	(2) Non-financial crisis	(3) Covid	(4) Non-covid
CPS	0.0878	0.0995**	0.0405	0.101**
	(0.0860)	(0.0417)	(0.145)	(0.0393)
CEO_Age	-0.00110	0.00125*	0.00224	0.000615
	(0.00120)	(0.000684)	(0.00248)	(0.000631)
CEO_ female	-0.0543*	0.0101	-0.00788	0.00465
	(0.0318)	(0.0158)	(0.0336)	(0.0160)
Delta	-0.0170***	-0.0159***	-0.0246***	-0.0151***
	(0.00536)	(0.00343)	(0.00953)	(0.00334)
CEO_Tenure	-0.0156	-0.0183***	-0.00904	-0.0184***
	(0.0112)	(0.00613)	(0.0208)	(0.00540)
CEO_Edu	0.00973	0.00901	0.0500	0.00511
	(0.0162)	(0.00886)	(0.0306)	(0.00848)
SIZE	-0.0342***	-0.0442***	-0.0489***	-0.0420***
	(0.00631)	(0.00456)	(0.0128)	(0.00420)
Growth	-0.0349	0.00798	0.0236	-0.00400
	(0.0271)	(0.0197)	(0.0687)	(0.0170)
Profit	-0.178***	-0.204***	-0.171	-0.194***
	(0.0490)	(0.0423)	(0.139)	(0.0349)
R&D %	-0.231**	0.0709	0.238	-0.0227
	(0.0940)	(0.0873)	(0.287)	(0.0762)
Growth_oppo	-0.00154	0.000328	-0.00239	0.000247
	(0.00163)	(0.000531)	(0.00149)	(0.000534)
CAPEX	-0.0404	-0.00760	0.0345	-0.0174
	(0.0367)	(0.0284)	(0.0495)	(0.0243)
Leverage	0.361***	0.203***	0.513***	0.229***
	(0.0812)	(0.0548)	(0.142)	(0.0503)
Cash_surp	0.0547	-0.0266	0.0273	-0.00896
	(0.0561)	(0.0395)	(0.123)	(0.0376)
Div_cut	-0.0397**	-0.0209**	-0.0576*	-0.0191**
	(0.0187)	(0.00936)	(0.0299)	(0.00839)
Board_size	0.000470	0.000788	0.00489	1.69e-05
	(0.00252)	(0.00151)	(0.00477)	(0.00143)
% Female	-0.109	-0.150***	-0.150	-0.148***
	(0.0785)	(0.0511)	(0.162)	(0.0458)
Crisis_C	0	0.239***	-	-
	.	(0.0830)	-	-
Crisis_F	-	-	0	0.223***
	-	-	.	(0.0587)
GDP_ Growth	0.0184	0.0132	-0.0496	-0.00419
	(0.0143)	(0.0138)	(0.0878)	(0.00798)
Inflation_Rate	0.0689**	0.00478*	-0.0630	0.0241**
	(0.0273)	(0.00253)	(0.0793)	(0.0118)
Foreign_ Inv	-0.0174	0.00346	0.0999	0.00299
	(0.0110)	(0.00256)	(0.148)	(0.00231)

Trade (% of GDP)	-0.0116	-1.235***	-0.00560	0.00420**
	(0.0125)	(0.243)	(0.00638)	(0.00196)
Constant	-0.183	0.0132	-1.103***	-1.229***
	(1.022)	(0.0138)	(0.356)	(0.255)
Year fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
country fixed effect	Yes	Yes	Yes	Yes
Observations	2,652	10,109	965	11,796
R-squared	0.253	0.245	0.204	0.252
F-statistic	61.53	38.04	7.36	36.71
Chow test	F(2, 1537) = 11.22***		F (2, 1537) = 5.52***	

ii. Difference in difference approach (DiD)

Re-examine the same matter on the relationship between CEO power and tail risk during crisis and non-crisis. We also employ the DiD approach, as suggested by (Bakke et al. 2016), to assess the differences in a response variable (i.e., firm tail risk) across a category (i.e., companies led by powerful CEOs) without treatment (i.e., companies led by less powerful CEOs). The main variable, CPS, is converted into a dummy variable (Cpower_D). When a firm's CPS is higher than the industry median (i.e. if a powerful CEO runs it), this dummy takes one; otherwise, it is zero. Dummies capture periods of covid 2020, and the financial crisis of 2007 (Crisis_C and Crisis_F, respectively), and an interaction term between the CPS dummy and COVID-19 dummy (Cpower_Covid) and between the CPS dummy and financial crisis dummy (Cpower_Crisis) will be included in the baseline OLS equation 6 (see equation 8):

$$ES_{i,t}/ES_{Idio_{i,t}}/ES_{Sys_{i,t}} = \alpha_{i,t} + \beta_1 * Cpower\_D_{i,t} + \beta_2 * \quad power\_ \quad ovid + \beta_3 * \quad risis\_ \quad + \beta 4 * Cpower\_Crisis + \beta_5 * Crisis\_F + \varphi X_{i,t} + Year.FE + Industry.FE + Country.FE + \epsilon_{i,t} \qquad (8)$$

According to the results presented in Table 9, based on the positive and statistically significant coefficients of the two crisis dummies for the covid crisis (Crisis_C) and financial turmoil (Crisis_F), we can conclude that the firm tail risk tends to be higher by approximately 15-20% during financial and health crises. This is sensible given that during crisis times, firms are subjected to more uncertainty, resulting in strong and excessive stock price fluctuations.

Compared to the sub-sampling method discussed in Section 6.c.i, an inconsistent conclusion regarding crises' influence on CEO power and firm tail risk is reached. Both interaction terms between CEO power and covid crisis (cpower_covid) and financial crisis (cpower_crisis) reveal insignificant coefficients across all three tail risk measures. This indicates that the impacts of CEO power on tail risk remain indifferent across crisis and non-crisis periods. According to the DiD approach, it is expected that CEOs with greater power and control over the company maintain the exercise of their power similarly during regular and difficult operating periods, standing to their views and characteristics (i.e., optimism and spotting uncertainties). Thus, economic, financial, or health difficulties would not affect CEO power and firm tail risk.

Table 9: CEO power and firm tail risk across financial and health crises – Difference in Difference (DiD)

Table 9 illustrates the results from the conducted difference in difference (DiD) method of the relationship between CEO power and firm tail risk during financial, non-financial, and COVID, non-COVID crises. ***ES*** refers to the negative value of the average firm's stock loss of the 5% worst returns annually, ***ES_Idio*** refers to the negative values of the average of the day-to-day residuals returns that are recorded as the 5th percentile of the yearly distribution, ***ES_Sys*** refers to the negative values of the average of the day-to-day predicted returns that are recorded as the 5th percentile of the yearly). **Cpower_D** is a dummy variable denoting unity if the CEO pay slide (CPS) is greater than the median value of the sample and zero otherwise. **Crisis_C and Crisis_F** capture Financial and Covid crises equal to 1 if the firm-year observations fall in 2007-2009 and 2020-2021, respectively, and 0 otherwise. ***CEO_Age*** biological age of the CEO (in years). **Cpower_covid** is the term for the interaction between Cpower_D and Crisis_C. **Cpower_crisis** is the term for the interaction between Cpower_D and Crisis_F. ***CEO-female*** as dummy representation, one if the CEO is a female and 0 if not. ***Delta*** is a natural logarithmic representation of CEOs' wealth change in dollar value for one parentage change in stock price. ***CEO_Tenure*** is the natural logarithm of the time spent as a firm CEO. ***CEO_Edu*** dummy representation of 1 if the CEO owns a master's or above degree, or 0 if not. Size firm total asset logarithmic representation. ***Growth*** sales annual growth rate percentage. ***Profit*** earnings before interest payments and income taxes to total assets ratio. R&D is the percentage of research and development expenses to total assets. ***Growth _oppo*** the ratio of Market-to-book. ***CAPEX*** is defined as the percentage of net fixed assets to total assets. ***Div_cut*** dummy representation of 1 if the annual dividend payout decreased and 0 if not. ***Board_size*** is the total number of directors on the firm's board. ***% Female,*** the division of female directors on board. ***Financial and COVID crisis*** dummy representation of 1 if the observation of firm-year fall between 2007 to 2009 and between 2020 to 2021, respectively, and 0 if not**.** ***GDP_growth*** calculates the GDP growth (economic growth) percentage of the countries. ***Inflation_rate*** annual change percentage in the countries' consumer price index (CPI). ***Foreign_Inv*** calculates the percentage of foreign direct investment in the countries' GDP. ***Trade (% of GDP)*** calculates the % of the country's trade of their GDP. Standard errors are in parentheses. *, **, and *** denote statistical significance levels at 10%, 5%, and 1%, respectively.

Variable	ES	ES-Idio	ES-Sys
Cpower_D	0.0292***	0.0330***	0.0408***
	(0.00986)	(0.0125)	(0.0123)
cpower_covid	-0.0231	0.00213	0.00926
	(0.0330)	(0.0374)	(0.0357)
Crisis_C	0.156**	0.166**	0.0862
	(0.0741)	(0.0783)	(0.0769)
cpower_crisis	0.0175	0.0281	0.0143
	(0.0164)	(0.0203)	(0.0199)
Crisis_F	0.188***	0.168***	0.124**
	(0.0616)	(0.0649)	(0.0634)
CEO_Age	0.000621	0.000165	0.000220
	(0.000626)	(0.000821)	(0.000835)
CEO_ female	-0.00431	-0.0159	-0.0186
	(0.0148)	(0.0175)	(0.0164)
Delta	-0.0106***	-0.0126***	-0.0133***
	(0.00300)	(0.00376)	(0.00349)
CEO_Tenure	-0.0179***	-0.0222***	-0.0176***
	(0.00549)	(0.00681)	(0.00657)
CEO_Edu	0.0119	0.0182*	0.0196**
	(0.00821)	(0.0104)	(0.00995)
SIZE	-0.0416***	-0.0706***	-0.0470***
	(0.00426)	(0.00575)	(0.00546)
Growth	-0.0215	-0.0584*	-0.0665**
	(0.0264)	(0.0301)	(0.0260)
Profit	-0.198***	-0.246***	-0.223***
	(0.0357)	(0.0416)	(0.0397)
R&D %	-0.0117	-0.0299	-0.0656
	(0.0758)	(0.107)	(0.106)
Growth_oppo	-0.000164	-0.00153**	-0.00147**
	(0.000497)	(0.000603)	(0.000584)
CAPEX	-0.0130	-0.0374	-0.0475
	(0.0239)	(0.0312)	(0.0310)
Leverage	0.256***	0.269***	0.161**
	(0.0507)	(0.0702)	(0.0681)
Cash_surp	0.0125	-0.0692	-0.0986**

	(0.0366)	(0.0524)	(0.0483)
Div_cut	-0.0266***	-0.0678***	-0.0596***
	(0.00890)	(0.0116)	(0.0109)
Board_size	0.00284*	0.00400**	0.00445**
	(0.00152)	(0.00187)	(0.00180)
% Female	-0.138***	-0.150**	-0.117**
	(0.0462)	(0.0628)	(0.0591)
GDP_ Growth	0.00256	-0.00175	-0.00888
	(0.00777)	(0.00808)	(0.00792)
Inflation_Rate	-0.00289	0.000519	-0.00627
	(0.00921)	(0.00943)	(0.00915)
Foreign_ Inv	0.00102	-0.00316	-7.65e-05
	(0.00221)	(0.00256)	(0.00250)
Trade (% of GDP)	-0.000443	-0.000819*	-0.000488
	(0.000393)	(0.000470)	(0.000463)
Constant	-1.365***	-0.827***	-1.409***
	(0.0931)	(0.111)	(0.108)
Year fixed effect	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes
Observations	12,761	12,607	12,612
R-squared	0.244	0.295	0.232
F-statistic	53.97	38.66	39.70

iii. Difference in difference (DiD) with Propensity score matching (PSM)

In this section, we employ the PSM approach and DiD with PSM to test for the effect of CEO power on tail risk and the moderating effects of the financial crisis of 2007 and the COVID-19 crisis on such impact, respectively. The propensity score matching method has been widely employed to tackle the issue of selection bias (Li et al., 2023). Placing the CEO power dummy as the dependent variable of the logistic test reveals that the powerful CEO sample is usually younger, female, and with lower tenure. To further say, it is possible for confounding effects such that the stereotypic characteristics of CEOs are determinants of a higher firm tail risk rather than the CEO power itself.

Table 10 (Panel A) presents the results of the stand-alone PSM approach to test for Hypothesis 1 on the relationship between CEO power and tail risk. After matching powerful and non-power CEOs with identical characteristics, the results show that the average firm total tail risk measured by the expected shortfall (ES) of the powerful-CEO sample is significantly higher than that of the non-powerful matching CEO sample (Δ = 0. 0260, p-value < 0.1). Indeed, those findings confirm the concluded statement of the conducted baseline OLS estimation and various robustness checks.

Re-examining Hypothesis 2 in Table 10 (Panel B & Panel C) presents results of the PSM approach on the following subsamples: financial crisis versus non-financial crisis and COVID crisis versus non-COVID crisis, respectively. Subsequently, DiD test statistics are conducted to examine the differences in the CEO power's impacts on tail risk across the crisis and non-crisis periods.

The results of subsamples show no significant effect of CEO power on tail risk during financial and COVID-19 crises. However, in non-financial and non-COVID-19 crises, there is a statistically significant difference in tail risk between powerful and non-powerful CEOs. The differences in tail risk are 2.2% for non-financial crises and 1.93% for non-COVID-19 crises, statistically significant at a 10% critical level. This indicates that the CEO's power is primarily exercised in normal operation times, not turbulence. It is possible that during crises (both financial and health), CEOs should be more cautious and reluctant when making decisions involving excessive risk-taking.

When comparing the impact of CEO power on tail risk between financial and non-financial crises, the difference is only 0.27%. Similarly, the difference in CEO power's effect on tail risk between COVID-19 and non-COVID-19 crises is 3.98%. The difference is economically significant but is not statistically significant. This suggests that there is no significant difference in the impact of CEO power on tail risk between crisis and non-crisis time. In other words, the effects of CEO power on tail risk are indifferent across crisis and non-crisis times, supporting the findings obtained by a sub-sample approach that CEO power only increases firm risk during non-financial and non-covid crisis times.

In sum, although the impact of CEO power on tail risk remains relatively similar across crisis and non-crisis periods (both financial and health), attention should be paid to the finding that CEOs are less likely to utilise their power to commit excessive risk-taking behaviours.

Table 10: Propensity score matching (PSM) on the CEO power and tail risk – Moderating effects of crises

*Table 10 illustrates the propensity matching score (PSM) achieved results of the average treatment effects (ATE) and the average treatment effect on the treated ( ) with 1:1 matching. Presented by (Δ) and of CEO power on firm tail risk is estimated by the mean changes of firms with powerful s (column " reated") and identical firms with non-powerful CEOs (column" on-treated") difference. lso, the final column represents the T-statistics with robust standard errors. *** p<0.01, ** p<0.05, * p<0.1.*

			Treated	Control	Δ	S.E.	T-stat
Panel A: PSM on CEO power and firm tail risk							
Full sample	***EPS***	Unmatched	-1. 8519	-1. 8080	0. 0439	0. 0072	-6.08
		Matched - ATT	-1. 8521	-1. 8782	0. 0260***	0. 0110	2.36
Panel B: Difference in Difference with PSM: financial and non-financial crisis							
Financial Crisis	***EPS***	Unmatched	-1. 7458	-1. 7189	-0. 0269	0. 0157	-1.71
		Matched - ATT	-1. 7469	-1. 7666	0. 0197	0. 0222	0.89
Non-financial Crisis	***EPS***	Unmatched	-1.8806	-1. 8301	-0. 0504	0. 0080	-6. 27
		Matched - ATT	-1. 8806	-1. 9031	0. 0224*	0. 0118	1.90
		Δ – Δ -crisis)			0.0027		0.10739
Panel C: Difference in Difference with PSM: COVID and non-COVID crisis							
Covid Crisis	***EPS***	Unmatched	-1. 6976	-1. 6503	-0. 0472	0. 0315	-1.50
		Matched - ATT	-1. 6924	-1. 7516	0. 0591	0. 0395	1.50
Non-Covid Crisis	***EPS***	Unmatched	-1.8633	-1.8226	-0.0407***	0.0073	-5.57
		Matched - ATT	-1. 8638	-1. 8831	0. 0193*	0. 0115	1.67
	Δ	**– Δ - health crisis)**			0.0398		0.9674

d. Additional analyses

Lastly, we conduct further analyses to understand the relationship between CEO power and tail risk. The full baseline model is implemented on subsamples of financial and non-financial firms, high-growth and low-growth samples, and high-R&D and low-R&D firms.

i. Additional analysis: CEO power on firm tail risk across non-financial and financial firms

Table 11 shows the differences in CEO power and firm tail risk across non-financial and financial firms. The results indicate that CEO power is positively associated with firm tail risk only in non-financial firms. In other words, the obtained results are primarily driven by non-financial companies. Coefficients of CEO power (CPS) obtained after excluding financial firms are relatively similar to those obtained in the central finding. This finding may be because of the strict regulations and guidelines imposed on financial firms and tight analysts following. In financial institutions, CEOs must make careful decisions, even with power, since market participants closely monitor their firms' behaviour and performance (Elyasiani & Zhang, 2015). Therefore, it is more challenging for CEOs to exercise their power (being optimistic and overconfident) to commit to aggressive risk-taking, leading to tail risk exposure.

Table 11: Influences of CEO power on firm tail risk – Non-Financial and Financial

Table 11 illustrates the relationship between CEO power tail risk amongst non-financial (Panel A) and financial (Panel B) using OLS with cluster standard error at the firm level. ***ES*** refers to the negative value of the average firm's stock loss of the 5% worst returns annually, ***ES_Idio*** refers to the negative values of the average of the day-to-day residuals returns that are recorded as the 5th percentile of the yearly distribution, ***ES_Sys*** refers to the negative values of the average of the day-to-day predicted returns that are recorded as the 5th percentile of the yearly). ***CPS*** is defined as the total compensation of CEOs against the total compensation of the top five executives in individual firm percentages. ***CEO-Age*** CEO's biological age in years. ***CEO-female*** as dummy representation, one if the CEO is a female and 0 if not. ***Delta*** is a natural logarithmic representation of CEOs' wealth change in dollar value for one parentage change in stock price. ***CEO_Tenure*** is the natural logarithm of the time spent as a firm CEO. ***CEO_Edu*** dummy representation of 1 if the CEO owns a master's or above degree, or 0 if not. Size firm total asset logarithmic representation. ***Growth*** sales annual growth rate percentage. ***Profit*** earnings before interest payments and income taxes to total assets ratio. R&D is the percentage of research and development expenses to total assets. ***Growth _oppo*** the ratio of Market-to-book. ***CAPEX*** is defined as the percentage of net fixed assets to total assets. ***Div_cut*** dummy representation of 1 if the annual dividend payout decreased and 0 if not. ***Board_size*** is the total number of directors on the firm's board. ***% Female,*** the division of female directors on board. ***Financial and COVID crisis*** dummy representation of 1 if the observation of firm-year fall between 2007 to 2009 and between 2020 to 2021, respectively, and 0 if not. ***GDP_growth*** calculates the GDP growth (economic growth) percentage of the countries. ***Inflation_rate*** annual change percentage in the countries' consumer price index (CPI). ***Foreign_Inv*** calculates the percentage of foreign direct investment in the countries' GDP. ***Trade (% of GDP)*** calculates the % of the country's trade of their GDP. Standard errors are in parentheses. *, **, and *** denote statistical significance levels at 10%, 5%, and 1%, respectively.

	Panel A: Non-financial firms			Panel B: Financial firms		
Variable	(1) ES	(2) ES-Idio	(3) ES-Sys	(4) ES	(5) ES-Idio	(6) ES-Sys
CPS	0.0995**	0.141***	0.170***	-0.0706	-0.115	-0.129
	(0.0409)	(0.0509)	(0.0495)	(0.0881)	(0.0982)	(0.100)
CEO_Age	0.000823	0.000328	0.000378	-0.000341	0.000825	-0.00192
	(0.000651)	(0.000858)	(0.000841)	(0.00142)	(0.00170)	(0.00167)
CEO_ female	0.000169	-0.00764	-0.00754	0.0599*	0.0481	0.0556
	(0.0156)	(0.0186)	(0.0173)	(0.0357)	(0.0413)	(0.0422)
Delta	-0.0159***	-0.0198***	-0.0207***	0.00645	0.0118	0.00937
	(0.00328)	(0.00406)	(0.00384)	(0.00732)	(0.00893)	(0.00888)
CEO_Tenure	-0.0179***	-0.0220***	-0.0176***	-0.0290***	-0.0374***	-0.0239**
	(0.00569)	(0.00708)	(0.00682)	(0.0110)	(0.0131)	(0.0118)
CEO_Edu	0.0109	0.0181*	0.0198*	-0.0350*	-0.0407**	-0.0263
	(0.00853)	(0.0109)	(0.0104)	(0.0181)	(0.0202)	(0.0181)
SIZE	-0.0442***	-0.0747***	-0.0527***	-0.0293***	-0.0417***	-0.0185*
	(0.00446)	(0.00611)	(0.00590)	(0.00884)	(0.0119)	(0.0108)
Growth	-0.00197	-0.0173	-0.0237	-0.0325	-0.0467	-0.116
	(0.0174)	(0.0198)	(0.0171)	(0.0907)	(0.113)	(0.111)
Profit	-0.183***	-0.225***	-0.198***	-0.636**	-0.672**	-0.718***
	(0.0361)	(0.0424)	(0.0405)	(0.248)	(0.280)	(0.270)
R&D %	-0.00597	-0.0285	-0.0677	0.378	0.218	0.209
	(0.0743)	(0.105)	(0.103)	(0.254)	(0.293)	(0.275)
Growth_oppo	-4.11e-05	-0.00147**	-0.00146**	0.000516	0.000202	0.000864
	(0.000529)	(0.000638)	(0.000615)	(0.000686)	(0.000739)	(0.000806)
CAPEX	-0.0177	-0.0459	-0.0561*	-0.0238	-0.0258	-0.0432*
	(0.0258)	(0.0333)	(0.0333)	(0.0237)	(0.0262)	(0.0249)
Leverage	0.246***	0.266***	0.153**	0.175	0.116	0.0655
	(0.0513)	(0.0722)	(0.0707)	(0.147)	(0.164)	(0.143)
Cash_surp	-0.0105	-0.0955*	-0.124**	0.0203	0.0258	-0.0389
	(0.0382)	(0.0544)	(0.0500)	(0.131)	(0.143)	(0.129)
Div_cut	-0.0273***	-0.0682***	-0.0611***	0.0303	0.0192	0.0118
	(0.00870)	(0.0116)	(0.0110)	(0.0293)	(0.0334)	(0.0286)
Board_size	0.000892	0.00113	0.00117	-0.000449	-0.000205	0.000622
	(0.00151)	(0.00192)	(0.00188)	(0.00223)	(0.00235)	(0.00244)
% Female	-0.153***	-0.168**	-0.139**	-0.0164	-0.0497	-0.0740
	(0.0485)	(0.0664)	(0.0626)	(0.111)	(0.141)	(0.131)
Crisis_F	0.278***	0.313***	0.322***	0.295***	0.279**	0.430***
	(0.0621)	(0.0679)	(0.0649)	(0.109)	(0.127)	(0.123)
Crisis_C	0.198***	0.270***	0.266***	0.247**	0.266*	0.347**
	(0.0677)	(0.0759)	(0.0734)	(0.121)	(0.146)	(0.136)
GDP_ Growth	0.00688	0.00642	0.00703	0.0167	0.0137	0.0342**
	(0.00750)	(0.00808)	(0.00787)	(0.0143)	(0.0162)	(0.0163)
Inflation_Rate	0.0136	0.0208**	0.0235**	0.0289	0.0376	0.0551**
	(0.0104)	(0.0104)	(0.0103)	(0.0217)	(0.0264)	(0.0267)
Foreign_ Inv	0.00281	-0.000427	0.00227	0.00602	0.00806	0.00750
	(0.00240)	(0.00278)	(0.00272)	(0.00637)	(0.00906)	(0.00734)
Trade (% of GDP)	0.00400**	0.00707***	0.00642**	0.00253	0.000898	0.00189

	(0.00203)	(0.00253)	(0.00252)	(0.00507)	(0.00636)	(0.00597)
Constant	-1.193***	-0.890***	-1.667***	-1.525***	-1.363***	-1.738***
	(0.272)	(0.313)	(0.285)	(0.369)	(0.435)	(0.393)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,069	11,915	11,920	692	692	692
R-squared	0.251	0.302	0.240	0.418	0.339	0.362
F-statistic	48.35	38.95	39.60	16.29	10.87	13.36

ii. *Additional analysis: CEO power and firm tail risk across firms with different growth opportunities and R&D Expenses*

Finally, we further investigate how the CEOs influence the tail risk by varying growth opportunities (Panel C) and R&D (Panel D) spending levels of the firm. The results show that high-growth and low-growth firms obtain significant positive relationships between CEO power and tail risk. The influence of CEO power is dampened for fast-growing companies, suggesting a lesser economic impact overall. In other words, when companies have limited potential growth, CEOs are more likely to use their power to enhance the firm's risk, leading to an increase in firm tail risk if they make irrational decisions. According to R&D expense, CEO power is positively associated with firm risk, which firms with low R&D expenditures mainly drive. Particularly, the coefficient of CEO power lost its significance in high-R&D-spending firms. This may be because firms' R&D spending is linked to their risk-taking capacity (Yung & Chen, 2018). When companies spend less on R&D, they have a lower risk level and, hence, high risk-taking capacity compared to companies that pay more on R&D. With such an available risk-taking capacity, powerful CEOs are likely to be exposed to excessive risk behaviours leading to higher tail risk.

Table 12: CEO power-risk relationship across firms with different growth opportunities and research and development expenditure

Table 12 demonstrates the relationship between CEO power and firm risk tail among high-growth and low-growth firms using both high and low R&D expenditure using OLS with cluster standard error at the firm level. ***ES*** refers to the negative value of the average firm's stock loss of the 5% worst returns annually. ***CPS*** is defined as the total compensation of CEOs against the total compensation of the top-five executives in individual firm percentages. ***CEO-Age*** CEO's biological age in years. ***CEO-female*** as dummy representation, one if the CEO is a female and 0 if not. ***Delta*** is a natural logarithmic representation of CEOs' wealth change in dollar value for one parentage change in stock price. ***CEO_Tenure*** is the natural logarithm of the time spent as a firm CEO. ***CEO_Edu*** dummy representation of 1 if the CEO owns a master's or above degree, or 0 if not. Size firm total asset logarithmic representation. ***Growth*** sales annual growth rate percentage. ***Profit*** earnings before interest payments and income taxes to total assets ratio. R&D is the percentage of research and development expenses to total assets. ***Growth _oppo*** the ratio of Market-to-book. ***CAPEX*** is defined as the percentage of net fixed assets to total assets. ***Div_cut*** dummy representation of 1 if the annual dividend payout decreased and 0 if not. ***Board_size*** is the total number of directors on the firm's board. ***% Female,*** the division of female directors on board. ***Financial and COVID crisis*** dummy representation of 1 if the observation of firm-year fall between 2007 to 2009 and between 2020 to 2021, respectively, and 0 if not. ***GDP_growth*** calculates the GDP growth (economic growth) percentage of the countries. ***Inflation_rate*** annual change percentage in the countries' consumer price index (CPI). ***Foreign_Inv*** calculates the percentage of foreign direct investment in the countries' GDP. ***Trade (% of GDP)*** calculates the % of the country's trade of their GDP. Standard errors are in parentheses. *, **, and *** denote statistical significance levels at 10%, 5%, and 1%, respectively.

Panel A: Growth Opportunity and Panel B: R&D Expenditure

Variable	(1) High Growth	(2) Low Growth	(3) High R&D	(4) Low R&D
CPS	0.0708*	0.138**	0.0528	0.130***
	(0.0374)	(0.0674)	(0.0599)	(0.0498)
CEO_Age	0.000348	0.00152	0.000940	0.000712
	(0.000577)	(0.00109)	(0.000997)	(0.000711)
CEO_ female	0.0108	-0.00484	-0.0114	0.00992
	(0.0132)	(0.0307)	(0.0309)	(0.0156)
Delta	-0.0111***	-0.0220***	-0.0185***	-0.0131***
	(0.00296)	(0.00513)	(0.00461)	(0.00341)
CEO_Tenure	-0.0107**	-0.0363***	-0.0237***	-0.0141***
	(0.00532)	(0.0104)	(0.00909)	(0.00527)
CEO_Edu	0.00165	0.0236	0.00272	0.00993
	(0.00801)	(0.0164)	(0.0137)	(0.00851)
SIZE	-0.0426***	-0.0424***	-0.0488***	-0.0364***
	(0.00487)	(0.00530)	(0.00554)	(0.00356)
Growth	0.00255	-0.00504	0.00334	-0.0185
	(0.0188)	(0.0246)	(0.0221)	(0.0238)
Profit	-0.212***	-0.167***	-0.155***	-0.267***
	(0.0439)	(0.0468)	(0.0385)	(0.0593)
R&D %	-0.0428	0.0317	-0.0489	-1.734***
	(0.0922)	(0.0919)	(0.0706)	(0.564)
Growth_oppo	2.48e-05	0.00179	-2.07e-05	-0.000289
	(0.000844)	(0.00142)	(0.000803)	(0.000512)
CAPEX	-0.0308	-0.0146	-0.0144	-0.0274
	(0.0439)	(0.0257)	(0.0281)	(0.0308)
Leverage	0.196***	0.256***	0.295***	0.223***
	(0.0632)	(0.0673)	(0.0967)	(0.0525)
Cash_surp	0.0208	-0.0473	-0.0659*	0.0148
	(0.0364)	(0.0557)	(0.0366)	(0.0572)
Div_cut	-0.0229***	-0.0280*	-0.0827***	0.000293
	(0.00720)	(0.0162)	(0.0147)	(0.00915)
Board_size	0.000391	0.00119	0.00100	0.000477
	(0.00129)	(0.00254)	(0.00202)	(0.00129)
% Female	-0.121***	-0.167**	-0.0834	-0.176***
	(0.0463)	(0.0726)	(0.0729)	(0.0436)
Crisis_C	0.190***	0.391**	0.166	0.326***
	(0.0458)	(0.154)	(0.170)	(0.0568)
Crisis_F	0.194***	0.178	0.125	0.236***
	(0.0520)	(0.165)	(0.187)	(0.0624)
GDP_ Growth	0.00381	0.0160	-0.00868	0.0141**
	(0.00560)	(0.0195)	(0.0218)	(0.00681)
Inflation_Rate	0.00562	0.0261	0.0114	0.0119
	(0.00753)	(0.0286)	(0.0289)	(0.0106)
Foreign_ Inv	0.00284	0.00209	0.00904	0.000276
	(0.00188)	(0.00573)	(0.00566)	(0.00251)

Trade (% of GDP)	0.00590***	-0.000793	0.00823**	0.00169
	(0.00206)	(0.00355)	(0.00394)	(0.00179)
Constant	-1.541***	-0.863***	-1.248***	-1.284***
	(0.203)	(0.318)	(0.371)	(0.218)
Year fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
country fixed effect	Yes	Yes	Yes	Yes
Observations	8,627	4,134	4,946	7,815
R-squared	0.305	0.193	0.228	0.290
F-statistic	44.41	17.92	20.45	47.53

7. DISCUSSION AND CONCLUSIONS

The critical role of CEOs in managing risks within corporate structures is widely accepted. Effective decision-making by CEOs is fundamental in balancing internal and external risks, which can have significant consequences for a company's financial performance, survival, and long-term growth. Managing risks can be daunting for CEOs as the potential for heightened risk can result in unfavourable outcomes that may impede their company's growth. CEOS must exercise caution and implement effective risk management strategies to mitigate potential negative impacts. As such, this study aims to examine the effect of CEO power on firm tail risks, a detrimental type of risk for corporations, on an international scale. We also investigate such impact across different financial and health crises to understand the constructs better. Specifically, we employ a cross-country panel data sample containing publicly listed firms in G7 countries: the United States, the United Kingdom, Germany, France, Italy, Canada, and Japan. The investigation covers a period from 2006 to 2021 with 12,761 firm-year observations. This period includes the global financial crisis 2007 and the ongoing COVID-19 crisis. During crises, asset interdependence and financial market interconnection are critical. They can trigger systemic risk episodes, as demonstrated during the global financial crisis of 2007, the Eurozone debt crisis between 2010 and 2012, and the COVID-19 pandemic crisis of 2020 (Laborda & Olmo, 2021; Diebold & Yilmaz, 2015). In such market conditions, the trust and tolerance of shareholders are tremendously shaken, triggering their negative emotions, including anger and resentment of firms, leading to potential stock retirement and, hence, extreme falls in stock values (i.e., tail risk) (Fediuk et al., 2010). That is why firms are often exposed to more significant risks of extreme stock price depreciation during crises, heightening their pressure and caution. Such intensified stress is likely to modify the way CEOs utilise their power during crises, impacting extreme stock depreciation. It is likely to differ in comparison to "normal" operational circumstances.

Our study found that CEO power positively impacts firm-specific and market-related tail risk. To ensure the reliability of our findings, we employed various robustness tests. These included the use of alternative estimation models such as the lagged approach, fixed/random effects, the system General Method of Moment (GMM), and the 2-stage least square (2SLS). Our results consistently align with the baseline model, further reinforcing the robustness of our research. Additionally, the results obtained from the DiD methods (using interaction term and propensity score matching approach) further support our findings. These results indicate that the relationship between CEO power and tail risk significantly holds during financial and health crises, suggesting that powerful CEOs are more likely to take excessive risks in various economic conditions.

The findings indicate that a firm total tail risk and its two components, firm-specific and market-based tail risk, increase with CEO power. Consequently, the CEO power relationship with the expected shortfall and two expected shortfall components is economically significant. Also, all coefficients are statistically significant at 5% or below. This argument complements the premise of the behavioural agency model and the inhibition/approach theory. CEOs' risk-taking behaviour increases with power due to their propensity to be optimistic about their risk perception (Anderson & Galinsky, 2006). However, our findings indicate an intriguing finding that risk-related decisions made by CEOs vary depending on their possessed power. Particularly, more powerful CEOs are more likely to commit to aggressive risk decisions, leading to higher total tail risk. This effect holds for both components of tail risk: firm-specific and market-based tail risk. Across turbulent times such as financial and health crises, the relationship between CEO power and firm tail risk generally remains indifferent. Furthermore, the results are driven by non-financial firms and firms with available risk capacity regarding their low R&D expenditure. Employing an international sample of G7 countries, the findings can be more generalisable in a broader context than in a particular nation. It is worth noting that the study employs the most recent dataset, covering the period from 2006 to 2021, including recent market events such as the COVID-19 pandemic and numerous changes in governance codes worldwide.

The implications of this study are significant for firms, investors, regulators, and policymakers. For example, policymakers can use the evidence of this study as a proactive tool to anticipate the impact of crises on investors and markets by analysing how CEO power affects corporate tail risk. Regulators may also establish improved rules and regulations to minimise risks and prevent future turbulences. Moreover, based on the recommendations, firms and investors can get deeper insights into managing tail risks associated with powerful CEOs. This study helps enhance senior managers' hiring criteria and understanding of the tail risk associated with powerful CEOs during crises. The board of directors should pay more attention to the risks raised by powerful CEOs' decisions. This is because higher risks are expected to increase the excessive risk, which is detrimental to firms' growth. In other words, overseeing powerful CEOs' decisions is more likely to help manage tail risk. As this study's key findings disclose, CEO power is more likely to cause firm tail risk to increase. Ultimately, these conclusions can either confirm or contradict previous research on CEO characteristics and corporate tail risk, making this study a valuable addition.

Chapter 4: INTERNATIONAL EVIDENCE ON THE CEO POWER AND STOCK PRICE CRASH RISK: MODERATING EFFECT OF ENVIRONMENTAL PRACTICES.

Abstract

This paper investigates the effect of CEO power on corporate stock price crash risk at an international level, emphasising the global relevance of our research. We also explore how corporate environmental practices moderate this relationship, a topic of increasing importance in the global business landscape. Our analysis of data from publicly listed firms in the G7 nations from 2006 to 2021 reveals that firms led by more powerful CEOs are generally exposed to lower crash risks. Furthermore, we found that companies implementing stronger environmentally friendly practices, particularly those supporting climate actions SDG-13, experience a further reduced crash risk. This pattern is especially evident in non-crisis periods, non-financial firms, and firms with high environmental and social (ES) scores, i.e., CSR performance. The robustness of these findings is confirmed through various alternative estimation models, measures, and additional tests, providing a comprehensive understanding of this complex relationship and its global implications.

Keywords: CEO power; stock price crash risk; financial crisis; COVID-19 pandemic; environmental; SDG13; GHG emission

1. INTRODUCTION

Chief Executive Officers (CEOs), the key decision-makers of corporations, have been widely researched and debated in academia. Undoubtedly, CEOs are responsible for numerous strategic duties of a firm management. These include, e.g., decisions on strategic operations and planning; managing, reviewing and revising organisational structures; managing the firm productivity and profitability; communicating and maintaining harmonising relationships with stakeholders; and most importantly, controlling, assessing, and evaluating firm risk levels to avoid crash risk. Among many characteristics of CEOs, the institutional power that CEOs possess influences the firm overall operations and strategic decisions (Grinstein & Hribar, 2004). In corporate studies, there is a growing interest in examining the dynamic between CEO power and its potential effects on stock price crash risks (Al Mamun et al., 2020; Shahab et al., 2020; Kalia, 2024).

The concern around stock price crash risk has been amplified in recent years, highlighted by numerous studies pointing out the dangers of accumulating negative information (Kothari et al., 2009; Jin & Myers, 2006; Habib et al., 2018; Chen et al., 2021). The build-up of negative news resulted in the collapse of the stock price (Jin & Myers, 2006). Moreover, CEO power is identified as a contributing factor to increased crash risk. Al Mamun et al. (2020) and Tan and Liu (2016) highlight how powerful CEOs may conceal negative information, leading to greater vulnerability to stock price crashes. This aspect of corporate leadership underscores the challenges of information asymmetry and its potential to harm shareholder value and market stability. Conversely, literature has concluded that factors of more transparent and accountable corporate environments, including concentrated institutional ownership, institutional ownership by public pension funds, industry-specialized auditors, corporate social responsibility, religiousness in the company headquarters county, and accounting conservatism, are more probable to decrease the likelihood of future stock price crashes (Callen & Fang, 2015; Callen & Fang, 2013; Kim et al., 2014; An and Zhang, 2013; Kim & Zhang, 2016; Hutton et al., 2009; Jin & Myers, 2006; Robin & Zhang, 2015).

The relationship between powerful CEOs and stock price crash risk has yielded inconclusive results in the existing literature. Al Mamun et al. (2020) and Shahab et al. (2020) found that companies with more powerful CEOs have a higher stock price crash risk. Their studies focus only on one country, the US and China. In contrast, Kalia's (2024) study using Indian firms found that the more power a CEO has, the lower the crash risk. Different perspectives can be applied to explain the contradictory impact of powerful CEOs on crash risk. On the one hand, the managerial power theory perspective argues that powerful CEOs have greater influence in shaping their compensation contracts, which can motivate them to seek personal gains over stakeholder interests (Bebchuk et al., 2002). Such self-interest could lead these influential executives to withhold or delay sharing negative news with investors, allowing for the accumulation of internal problems. Eventually, accumulated bad news becomes public, leading to a crash in stock prices (Jin & Myers, 2006; Hutton et al., 2009). In contrast, the agency theory offers an alternative viewpoint. It suggests that power is a privileged treatment that CEOs are favoured to have. Hence, they are more inclined to maintain such a privileged status quo. Therefore, reputational and legal risks motivate even powerful CEOs to promptly disclose bad news rather than hide it, which may reduce the likelihood of stock price crash risk (Kasznik & Lev, 1995; Skinner, 1997). Extending the limited and inconclusive literature on this important area, our study employs a more vigorous dataset comprising multiple countries for investigation, offering a more comprehensive understanding of the impact of CEO power on stock price crash risk.

Another novel aspect of this study is exploring how corporate environmental practices moderate the relationship between powerful CEOs and stock price crash risk. Corporate environmental practices fall within the broader framework of corporate social responsibility. It represents one of CSR's core dimensions: environmental (E), social (S), and governance (G) (Aguinis, 2011; Malik, 2015; Mahran & Elamer, 2023; Percy, 2000). In recent decades, the environmental dimension has gained significant importance under the escalating threat of climate change (Henisz et al., 2019). Consequently, governments, regulators, and global organisations are encouraging firms to support executive incentives with GHG reduction to mitigate pollution and global warming (Al-Shaer & Zaman, 2019; Haque & Ntim, 2020). For example, the United Nations (UN) supports developing nations under SDG-13 (Sustainable Development Goal 13 – climate change actions) to promote sustainable and environmentally friendly operations to decrease consequences and promote low-carbon growth. This initiative promotes sustainability and aims to achieve two goals. The first goal is to decrease the global temperature by 1.5°C. The second goal is to reduce carbon dioxide emissions to less than 45% by 2030 and achieve net zero emissions by 2050. (Küfeoğlu, 2022). Under the environmental theme of climate change, this study focuses on two environmental practices of firms: GHG level, signifying the pollution level that firms generate, and whether firms support SDG-13 as moderating factors of CEO power–crash risk relation.

Environmental practices of firms as moderating factors, including GHG emission levels and SDG-13 goal, may shed light on the contexts and mechanisms through which corporate social responsibility and sustainability efforts could impact the CEO power-crash risk relationship. From a stakeholder perspective, companies that exhibit strong ESG scores and ratings show that their managers uphold ethical standards and care about broader stakeholder interests (Kim et al., 2014; Wang et al., 2021). High ESG scores reflecting ethical cultures may promote transparency and lower a CEO's propensity to hoard negative information over time, mitigating crash risk (Kim et al., 2014). However, other researchers adopt an agency-cost view regarding ESG initiatives. They cautioned that CSR could serve as a tool for powerful CEOs to hide negative news to worsen the impact of crash risk (Kim et al., 2014). Building on these views, good environmental practices can either genuinely reflect the high ethics and morals of the CEOs or are intentionally employed to conceal their actions. As a result, the low GHG level and SDG-13 support are predicted to encourage (discourage) CEOs to exercise their power to hoard bad news, leading to lower (higher) stock price crash risk.

The study applies a cross-country panel data sample of publicly listed companies in the G7 countries, which include the United States, United Kingdom, Canada, France, Japan, Italy, and Germany. The investigated period is from 2006 to 2021, including 11,189 firm-year observations. This period includes the 2007 global financial crisis and the COVID-19 pandemic. The G7 members account for over 60% of the world's net wealth and around 50% of global GDP (Climate Transparency, 2018). Their considerable populations and robust economies allow the G7 countries to be key players in global markets. They also maintain strong political, environmental, economic, cultural, and diplomatic relationships to bolster their economic situations and assist weaker economies worldwide, given their access to means of production and human capital.

Various estimation models have been conducted, including OLS regressions with a selection of robustness checks, to evaluate the effect of CEO power on stock price crashes and how this relationship changes across different environmental practices. The main findings indicate that firm crash risk (DUVOL and NSKEW) significantly decreases with CEO power. Specifically, the results indicate that for every one per cent increase in CEO power, stock price crash risk measured by DUVOL is reduced by 8%, and by NSCKEW is reduced by 32%. This argument complements the premise of the agency model. Across turbulent times such as financial and health crises, the relationship between powerful CEOs and firm crash risk generally remains indifferent. Furthermore, the results are driven by non-financial firms and firms with high CSR performance (measured by high ES scores). The results suggested that the negative impact of CEO power on crash risk and the mitigating effect of SDG-13 on this relationship are primarily driven by non-crisis periods. In other words, CEO power does not appear to decrease crash risk significantly during crisis periods (non-significant coefficients of CPS). However, when firms commit to SDG-13, CEOs can leverage their authority to promote transparency and reduce crash risk. This underscores the significance of market conditions in shaping the influence of CEO power on crash risk, as well as the critical role of SDG-13 environmental practices as a crucial ethical signal. To assure the validity and reliability of our main findings, we employ a few alternative models and alternative measurements including the additional explanatory variables, fixed/random effect model, Generalized Method of Moments (GMM), and Two-Stage Least Squares (2SLS), lagged dependent variable, and the weighted least square (WLS), to control for the issue of endogeneity (Trinh et al., 2020; Trinh et al., 2023; Ullah et al., 2018; Mollah & Zaman, 2015; Kashefi-Pour et al., 2020; Pindado et al., 2011). Additionally, the alternative proxy of CEO power is employed, i.e., the board independence (Lewellyn & Muller-Kahle, 2012; Daily & Johnson, 1997) and alternative measures of GHG emission level. We consider the indirect GHG level (scope two and scope 3) in the GHG measures. The robustness checks conducted through these alternative models and alternative measurements consistently validate our main findings, except for the GMM approach.

Our study makes two key contributions. Firstly, it examines the CEO power–crash risk relation in G7 nations – representing an international setting. This expands the limited literature in which research on CEO power and stock price crash risk has focused on single countries, limiting the generalisability of findings beyond a single country (Shahab et al., 2020; Al Mamun et al., 2020; Kalia, 2024). Using an international sample from the G7 countries will make this study's results more generalisable across different contexts. Secondly, this research explores further the moderating impacts of corporate environmental practices on such relationship*s*. Two environmental practices are examined: greenhouse gas (GHG) emissions and Sustainable Development Goal 13 (SDG-13 supporting climate action). This study addresses the research gap and uncertainty around the potentially moderating effects of GHG emissions and SDG-13 support on the relationship between CEO power and stock price crash risk. It offers empirical evidence to help resolve mixed perspectives on how CSR engagement shapes transparency and bad news-hoarding behaviours of influential executives during stable and turbulent macroeconomic periods.

The findings of our work provide practical implications for firms, investors, regulators, and policymakers. For example, policymakers can use this study evidence to proactively expect the impact of a crisis on investors and markets by analysing how CEO power influences corporate stock price crash risk. Based on the findings, regulators may establish improved rules to minimise crash risk and avoid future turbulence. Firms and investors can also gain deeper insight into managing the crash risk associated with powerful CEOs guided by the recommendations. The study also helps improve hiring criteria for senior managers and understanding of crash risk related to powerful CEOs during crises within the context of GHG emissions and SDG-13.

The remainder of the paper will be in the following order: Section 2 discusses the literature review on stock price crash risk. Section 3 outlines the theoretical frameworks based on which hypothesis. Section 4 describes the data sample, variables, and research methodology. Section 5 presents and discusses the empirical results and additional analyses. Finally, Section 6 concludes and summarises key findings, implications, and limitations.

2. LITERATURE REVIEW

In the 2000s, scholars and industry experts shifted the research paradigm to stock price crash risk due to its significance in capital markets (Bae et al., 2021). Numerous studies have examined the influencing factors of stock price crash risk and highlighted the growing significance of this topic among researchers and industry professionals (e.g., Kothari et al., 2009; Habib et al., 2018; Chen et al., 2021). Jin and Myers (2006) theoretically illustrated that managers are responsible for disclosing company-specific information and are motivated to take on some level of downside risk by delaying the release of negative information. For example, managers delay sharing information with investors to benefit from the company's cash flow or to protect their reputation, jobs, compensation packages, etc. (Jin & Myers, 2006; Kothari et al., 2009; Baginski et al., 2018; Andreou et al., 2017). However, when the accumulation of negative information hits a critical point, it becomes impossible for managers to keep it hidden. Such a situation necessitates information disclosure to the public. Once disclosed, information often triggers severe drops in stock prices, and crashes reflect a significant leftward skew in the return's distribution.

Corporate governance studies have recently emphasised the significance of specific CEO characteristics in relation to a firm perspective for stock price crashes. For example, CEO overconfidence, age, marital status, early-life disaster experience, location, adverse life events, stock gifts, birthplaces, and network centrality, are relevant indicators of firm crash risk studies (Kim et al., 2016; Andreou et al., 2017; Chen et al., 2021; Kim et al., 2022; Gu et al., 2022; Long et al., 2020; Choi et al., 2023; Pham et al., 2023; Chen et al., 2022; Krishnamurti et al., 2021).

Kim et al.'s (2016) research examined the linkage between CEO overconfidence and stock price crash risk and focused on the time from 1993-2010. His study included 17,568 data observations from firm-years. This study took into account firms within, as well as those previously part of, the S&P 1500 index. The findings indicated a higher crash risk for companies led by overconfident CEOs, especially when such CEOs held a dominant position in top management or when investor opinions differed. Moreover, Andreou et al. (2017) linked CEO age to stock crash risks. The study analysed data from 1995–2013 and covered 18,649 firm-year observations from 2,255 diverse industry firms. In their study, they excluded financial and utility firms. The conclusion was clear: firms with younger CEOs had an increased risk of stock price crashes. This includes downturns brought on by sudden negative news, which reduced their consistent earnings growth.

Chen et al. (2021) examined the effect of CEOs' experiences with early-life disasters on stock price crash risk using 1992-2015 data. The findings revealed that CEOs with early-life disaster experiences tend to be more risk-accepting. This makes them more inclined to withhold bad news, which can lead to stock price crashes.

Another study by Kim et al. (2022) explored the potential impact of marital status, societal convention, and cultural expectations on a firm’s stock price crash risk. The investigated data were from 1993 to 2008 of US publicly listed companies. The results indicated a significant pattern: Companies led by married CEOs showed a decreased likelihood of future stock price crash risk. Gu et al. (2022) also examined the relationship between location-based stereotypes of CEO trustworthiness and a firm stock price crash risk. Using a comprehensive trustworthiness dataset from a 2001 survey by Zhang and Ke (2002) through the Chinese Enterprise Survey System, a benchmark for evaluating trust levels across China's regions. The research analysed how regional trust stereotypes of CEOs relate to crash risk. The survey included data from over 15,000 firms across China's 31 provinces. As in Gu's findings, the data suggested that companies led by CEOs from wealthier regions were at a higher stock price crash risk. This highlights the "Trust Exploitation" effect: just because a CEO comes from a trusted region does not necessarily mean they uphold high ethical standards. This reputation might encourage some CEOs to manipulate this trust and hide negative information for longer.

Moreover, Long et al. (2020) examined the relationship between CEOs' personal adverse life events and firms' stock price crash risk. Drawing on a data set of Chinese companies covering the period from 2000 to 2015, totalling 22,513 firm-year observations. The research indicated that firms led by CEOs who lived during the disaster of the Great Chinese Famine in their early years showed a reduced stock price crash risk compared to those led by CEOs without such an experience. Notably, this protective effect of the Famine experience on stock price crash risk was even more different for companies where the CEO had substantial decision-making power and in the cases of non-state-owned businesses.

Choi et al. (2023) examined how a CEO's background or origin could impact a firm's stock price crash risk, drawing from data covering 13,331 firm-year observations from 1997 to 2017. Companies led by CEOs the company promotes showed a lower likelihood of stock price crash risk than those led by externally recruited CEOs. Additionally, we demonstrate that the adverse relation of having insider CEOs on stock price crash risk is particularly evident for firms that lean towards more cautious accounting policies.

Recently, Pham et al. (2023) work brought insight into an interesting aspect: viewing executives' stock gifts as agency costs to managers withholding negative information by examining a US firm from 1997 to 2016 and a final sample of 23,637 firm-year observations. The findings reveal that a stock price crash risk increase is associated with CEO stock gifts. This indicates that stock gifting might serve as a strategy for managers to reduce growing shares and protect their assets when they can no longer block out negative details about the company. Furthermore, Chen et al. (2022) sought to answer whether a CEO works in their birthplace influences a firm stock price crash risk compared to CEOs from elsewhere. Using data from China A-share listed companies covering the period from 2007 to 2019 (with financial firms excluded), the finding was that firms with CEOs working in their birthplaces exhibited a notable decrease in stock price crash risk.

Krishnamurti et al. (2021) explored how a CEO's networking skills—or network centrality—could impact a firm's future stock price crash risk. Drawing on data from S&P 1500 companies over two decades (1999 to 2019) with 12,540 firm-year observations, they found that firms directed by CEOs who held a more central position in their networks were less likely to withhold negative news, which protected against potential stock price crash risk.

Within the same research domain, a significant body of work has emerged, delving into the pivotal role of CEO power in determining crash risk. Al Mamun et al. (2020) present compelling evidence that CEO power, particularly from formal structural positions like founder, chairperson, and president, can significantly heighten crash risk. They argue that powerful CEOs, driven by personal incentives, may conceal negative information from capital market participants, thereby increasing the crash risk. Importantly, their findings remain robust even after accounting for earnings management, CEO overconfidence, and tax avoidance. Tan and Liu (2016) further bolster this argument by demonstrating a positive association between CEO power, as indicated by multiple board seats, and stock price crash risk.

Moreover, many studies have concluded that factors including concentrated institutional ownership, institutional ownership by public pension funds, industry-specialized auditors, corporate social responsibility, religiousness in the company headquarters county, and accounting conservatism are more probable to decrease the likelihood of future stock price crashes (Callen & Fang, 2015; An and Zhang, 2013; Kim et al., 2014; Callen & Fang, 2013; Kim et al., 2014; Kim & Zhang, 2016; Robin & Zhang, 2015; Hutton et al., 2009; Jin & Myers, 2006).

Despite the extensive research on stock price crash risks, a crucial and underexplored area of influence of CEOs' power on crash risk remains. Furthermore, to the best of our knowledge, no study has ventured into the international arena to explore the relationship between powerful CEOs and crash risk and to uncover the moderating impacts of environmental practices on this relationship. This underscores the pressing need for a comprehensive understanding of managers' actions and the responses of external and internal board members, their collective impact on crash risk, and the preservation of shareholders' value.

3. HYPOTHESIS DEVELOPMENT

a. CEO power and stock price crash risk

The influence of CEO power on stock price crash risk can be derived from theoretical and empirical perspectives. According to Jensen and Meckling (1976), agency theory is unarguably among the most prominent theories of organisational management, finance, and accounting (Demski & Feltham, 1978; Fama, 1980; Eisenhardt, 1985). One major assumption underlying the agency theory that acts as a key source of agency conflicts is the risk-averse nature of the managers (Bosse & Philips, 2016; Eisenhardt, 1989). Based on the assumption of risk avoidance characteristic of managers, CEOs might prefer to disclose bad news promptly, aiming to reduce potential legal repercussions, as noted by Kasznik and Lev (1995) and Skinner (1997). Such inclination to minimise the employment and reputational risk is more significant if CEOs possess more power because power is another privilege they do not want to risk. When this power comes from ownership, such as founder CEOs, leaders might have minimal motive to keep negative news. In other words, powerful CEOs prefer to avoid 'unethical' behaviours to maintain their status quo. Furthermore, Graham et al. (2017) and Al Mamun et al. (2020) suggest that powerful CEOs might be less concerned with keeping/hoarding the bad news due to their ability to handle the subsequent events with the given empowerment that they possess. Overall, from the agency's theoretical stand, CEO power is negatively associated with the stock price crash risk.

In contrast, the managerial power theory suggests the opposite. The theory posits that CEOs often prefer short-term objectives over long-term goals and misuse their power and firm resources to gain personal benefits (Grinstein & Hribar, 2004; Shahab et al., 2020; Conyon & He, 2011; Xu et al., 2014). They also tend to expose their firms to difficult financial situations (Shahab et al., 2020; Feng et al., 2011; Khanna et al., 2015). Therefore, the likelihood of CEOs pursuing their personal interests increases when they are delegated more power due to their influence on the board and decision-makers (Bebchuk et al., 2002; Shahab et al., 2020; Bebchuk & Fried, 2004). According to this theory, CEO power is a significant contagious influence linked to board effectiveness and firm performance (Bebchuk et al., 2011; Elmagrhi et al., 2020; Tian & Yang, 2014). As influencers, CEOs are more likely to be involved in the monitoring process of the top managers (Shahab et al., 2020). Thus, when CEOs have more power, the monitoring and the board are expected to be inefficient due to CEOs' influential involvement. This influence allows CEOs to expose their firms to higher stock price crash risk (Shahab et al., 2020).

From an empirical perspective, an inconclusive prediction of the relationship between CEO power and crash risk is also drawn. First, consistent with the agency theoretical view, the concept of the "quiet life" hypothesis, supported by scholars such as (Zhao & Chen, 2008 Bertrand & Mullainathan, 2003 Al Mamun et al., 2020), posits that well-entrenched managers often avoid activities that require substantial effort, including clouding the company information. In this respect, Jiraporn et al. (2014) illustrated that corporations directed by powerful CEOs tend to exhibit enhanced transparency. Given the insulation and security these CEOs enjoy, there is a lower likelihood of hiding information (Al Mamun et al., 2020). This leads to the conclusion that heightened CEO power might mitigate the crash risk. This negative relationship is further supported by an empirical finding obtained by Kalia (2024). The study examined how the power of CEOs affects the risk of stock prices crashing in India, looking at 236 companies listed on the S&P BSE 500 Index from 2014 to 2023. The study used two main measures of crash risk, the negative coefficient of skewness (NCSKEW) and Volatility (DUVOL), and revealed findings suggesting that the more power a CEO has, the lower the crash risk.

On the other hand, empirical evidence obtained by studies of Al Mamun et al. (2020) and Shahab et al. (2020) show a positive linkage between powerful CEOs and crash risk in the US and China, respectively. More specifically, Al Mamun et al. (2020) examined the US public companies between 1993 and 2013 with 24,300 firm-year observations after excluding the financial and utility sectors. The study concluded that uncontrolled power delegated to CEOs may increase the likelihood that they use their companies' resources for personal benefits by releasing misleading news and information to stakeholders, leading to crash risk. Similarly, Shahab et al. (2020) investigated the impact of powerful CEOs on stock price crash risk in China. They explored A-Share Chinese companies from Shanghai and Shenzhen stock markets between 2005-2015. Their research has 13,421 firm-year observations and uses the CEO pay slice (CPS) as a proxy to determine CEO power. Shahab et al.'s (2020) study employed two key crash risk indicators: Down to Up Volatility (DUVOL) and negative coefficient of skewness (NCSKEW). The research suggested a positive relationship between powerful CEOs and stock price crash risk. Interestingly, this link reduces with a higher authority of female directors and substantial ownership by block holders and institutions.

To conclude, the debate presented in this section indicates that the impact of CEO power on stock price crash risk is not straightforward based on theoretical and empirical views. Therefore, the CEO power and crash risk linkage in an international setting requires further empirical evaluation. Consequently, we propose the subsequent non-directional alternative hypothesis:

H1: CEO power significantly affects stock price crash risk.

b. The moderating effects of environmental practices: GHG emission level and SDG-13

ESG (Environmental, Social, and Governance) has become a crowded field, focusing significantly on firms' sustainability across these three dimensions. Studying general CSR (Corporate Social Responsibility) may not add much new or relevant insight to the existing body of research (Porter & Kramer, 2011). However, by concentrating specifically on the environmental aspect of ESG, including carbon emissions and environmental initiatives SDG13—we can make a more targeted and meaningful contribution. This focus allows for an insightful exploration of how environmental practices influence corporate behaviour and performance rather than diluting our analysis with a broader CSR view (García-Sánchez et al., 2020).

Additionally, firms that proactively engage in environmental practices can enhance their reputations, attract investment, and foster stakeholder trust, all of which can buffer against potential crises (Eccles et al., 2014). In contrast, neglecting environmental responsibilities can expose firms to significant risks, including regulatory fines, reputational damage, and operational disruptions (Baker & Nelson, 2005). Therefore, examining the environmental dimension of ESG enriches our understanding of sustainability and provides crucial insights into how CEO power can impact firm stability."

Extending the research topic, we aim to explore the role of environmental practices in influencing the relationship between CEO power and crash risk. We consider two primary aspects of firm environmental practices: greenhouse gas (GHG) emission levels and the adoption of SDG-13.

In corporate social responsibility (CSR), the environmental, social, and governance (ESG) standards represent key dimensions of a company's CSR impacts. ESG provides a more expansive terminology capturing environmental, social, and governance factors that support sustainable and ethical business practices (Gillan et al., 2021). As ESG has gained more attention globally, ESG scores are widely used to quantify companies CSR performance, given the focus on sustainability issues (Clément et al., 2023). Among the three dimensions, the environmental aspect (E) holds an essential position in ESG, covering various aspects such as energy consumption, waste discharge, resource utilisation, and their implications for the environment and humanity (Henisz et al., 2019). The environmental (E) concept also includes carbon emissions and climate change, where every global project seems to interact with and impacts the environment (Henisz et al., 2019). In recent decades, there has been a growing commitment on a global scale to mitigate the damages caused by climate change (Brooks & Schopohl, 2019). This commitment is evident in developing and implementing sustainable strategies by firms, nations, and international entities (Adu et al., 2022).

Corporations have increasingly focused on sustainable management, particularly pro-environmental initiatives, in the last decade (Lu & Herremans, 2019; Haque & Ntim, 2020; Adu et al., 2022; Sovacool et al., 2021). Furthermore, governments, regulators and global leaders know the increasing risks of severe climate crises (Choi & Luo, 2021; Haque & Ntim, 2018).

Consequently, firms are urged to adopt global incentives to participate in financially efficient or cost-effective projects to reduce greenhouse gas emissions (GHGs). Many world nations and organisations have implemented policies to reduce carbon emission risks (De Masi et al., 2021; Haque & Ntim, 2018). In 2009, the UK Department of Environment and Rural Affairs and Food issued guidelines for companies to reduce GHG emissions and global warming (Adu et al., 2022). This offers a guideline for firms to develop energy efficiency strategies while reducing carbon emissions (Adu et al., 2022). This GHG emission reduction goal seems to serve dual purposes: protecting the environment and advancing the interests of shareholders, which could potentially lead to heightened stock price benefits (SBPs), and the positive outcomes of these efforts extend beyond shareholders executives' duality. It also enhances humanity and environmental conditions, as highlighted in the research (North, 1991; Mazouz & Zhao, 2019). The purpose of the climate change plan goes beyond the world economy to include development and sustainability. For instance, the seventeen United Nations Sustainable Development Goals (SDGs) offer guidelines for member countries to create multinational enterprises to promote sustainable and equitable societies by 2030. It also addresses corporate sustainability criteria, including eco-efficiency, eco-effectiveness, and ecological equity. (Grover, Kar, and Ilavarasan, 2019).

Similarly, to develop a risk prevention plan to decrease climate change and economic consequences, the United Nations supports nations under SDG-13 (Sustainable Development Goal 13) to decrease consequences and promote low-carbon growth. This initiative by the United Nations also promotes sustainability and aims to achieve two goals. The first goal is to decrease the global temperature by 1.5°C. The second goal is to reduce carbon dioxide emissions to less than 45% by 2030 and achieve net zero emissions by 2050. (Küfeoğlu, 2022).

An SDG-13 support offers international business strategies to enhance and increase sustainable development practices. Thus, many multinational enterprises find it helpful to implement and adopt to increase their investments in sustainable development projects and govern their current business and interests (Grover et al., 2019).

We build our explanation of the moderating impacts of environmental practices on the relationship between CEO power and stock price crash risk on the stakeholder and signalling theories. The stakeholder theory proposes that companies have ethical obligations to stakeholders to promote their interdependencies (Freeman, 2015). Stakeholders provide essential and significant inputs to the firm. Hence, they have legitimate claims over resource allocation (Wernerfelt, 1984; Kock et al., 2012). However, managerial self-interest can generate conflicts between stakeholders and principals over a company's resource distribution (Tauringana & Chithambo, 2015; Kock et al., 2012). This arises from management focusing on their interests (Jain & Zaman, 2020) and the complex and unclear web of implicit and explicit agreements between a company and its stakeholders (Kock et al., 2012).

As essential elements within a company's CSR goals, pro-environmental practices constitute fundamental and continually evolving responsibilities, although not mandatory. They play a pivotal role in meeting the expectations of diverse pro-environmental stakeholders, including green shareholders. The alignment of business operations with environmental sustainability is perceived as a voluntary effort and a strategic necessity to address the concerns of stakeholders devoted to ecological responsibility, consequently reducing legitimate costs for firms. However, some argue that environmental projects are less attractive due to their high costs and suboptimal value attainment. Consequently, managers with opportunistic tendencies may hesitate to commit to these eco-friendly practices as they deplete financial resources that could otherwise be used for their interests.

In addition to the stakeholder theory, the signalling theory focuses on information asymmetries between organisations and stakeholders. Firms can employ CSR to signal positive organisational qualities and reduce information gaps (Connelly et al., 2011; Muttakin et al., 2015). A recent corporate governance study by Zhang and Wiersema (2009) reveals how CEOs signal their company's undetectable quality to prospective investors through the evident quality of their financial reports. Furthermore, Yim (2013) stressed that investments in CSR projects are made by top executives and ultimately approved by the most influential executives (i.e., the CEOs). Building on the signalling theory, two perspectives concern the moderating impact of environmental practices on the relationship between CEO power and crash risk. In essence, we attempt to learn whether firms with environmentally solid initiatives would diminish or amplify the tendency of CEOs to use their power to hoard bad news, affecting crash risk.

Regarding the first perspective, a stronger adoption of environmentally friendly practices (including lower GHG levels and SDG-13 support) signifies CEOs' strong 'ethical' inclination to satisfy and accommodate various stakeholder groups, extending beyond shareholders' explicit claims. Companies with stronger CSR cultures maintain high ethical principles in financial reporting. They show greater transparency through voluntary disclosure and are less likely to withhold negative news from investors, leading to lower crash risk (Gelb & Strawser, 2001; Wang et al., 2021; Kim et al., 2014). Consistent with this view, prior research indicates that strong CSR firms exhibit lower management earnings and reflect higher financial reporting quality (Kim et al., 2012). Furthermore, Hartzmark and Sussman (2019) indicate that strong sustainability funds experience fewer stock crashes. Given the implied ethicality of CEOs of firms with strong environmental practices, it is expected that they would be less inclined to exploit their power to withhold bad information and news for their benefit. This is because, for those CEOs, concealing unfavourable news is considered unethical, going against the will of the firm's key stakeholders, i.e., shareholders. Consequently, firms adopting a stronger environmental practice are expected to *negatively* moderate the effects of CEO power on stock price crash risk. In this view, the signalling theory effectively signals the ethical nature of CEOs through their dedication to environmental practices.

Conversely, existing literature acknowledges the potential for CEOs to exploit the signalling effect of markets when committing to pro-environmental projects, i.e., managerial motivations behind the CSR initiatives (McWilliams et al., 2006; Jensen & Meckling, 1976). This strategic use of environmentally friendly initiatives may serve as a tool for CEOs to build public trust, thereby aiding them in concealing corporate misbehaviours, including withholding unfavourable news or information (Wang et al., 2023; Hemingway & Maclagan, 2004). For instance, Enron was seen as a leading company in CSR, and the firm won many national prizes for environmental and community initiatives. Nevertheless, it was involved in extensive accounting fraud that caused it to collapse in 2001 (Kim et al., 2014; Bradley, 2009). Indeed, Friedman (1970) was one of the first to raise the concern that CSR may represent an agency issue within companies. Consistently, empirical research finds a positive relationship between corporate social responsibility (CSR) and earnings management (Prior et al., 2008; Petrovits, 2006). This view supports a prediction that strong environmental performances can act as a window-dressing tool for firms to maintain legitimacy and managerial reputations while committing unethical misconduct. Consequently, with such CSR protection, CEOs are more driven to exploit their power to obscure negative information, leading to higher crash risk.

Given the two conflicting perspectives, we develop a non-directional alternative hypothesis as follows:

H2: Environmental practices (GHG level and SDG-13 support) significantly affect the relationship between CEO power and stock price crash risk.

4. METHODOLOGY

a. Sample formation

Our study employs data from publicly listed companies across the main economies of the G7 nations, which include the USA, the UK, Germany, France, Italy, Canada, and Japan. The analysis covers the period from 2006 to 2021, which includes significant global events such as the financial collapse of 2007 and the COVID-19 pandemic of 2020. Data on accounting and financial information of firms and their daily stock market prices to compute stock price crash risk, together with environmental-related variables, are obtained from the Refinitiv Datastream database. On the governance front, data relating to board compensation and CEO characteristics are recovered from the WRDS BoardEx. Furthermore, the macroeconomic data is obtained from multiple sources such as the World Bank and International Monetary Fund databases. The final dataset that forms the basis of this study captures a significant 11,189 firm-year observations. Moreover, all financial variables are winsorising at the 1^{st} and 99^{th} percentiles to mitigate the impact of outliers (Kim & Lu, 2011).

b. Dependent variable: Stock price crash risk

Two established proxies were engaged to compute a company stock price crash risk: the negative skewness (NCSKEW) and the down-to-up volatility (DUVOL). These measurements have been considerably adopted in past scholarly studies to measure corporate stock price crash risk (e.g., Kim, Li, and Zhang, 2011; Xu et al., 2014; and Gu, Liu, and Peng, 2022). Initially, we derived firm-specific weekly returns through an extended market index model regression on a firm-yearly basis as follows:

$$r_{i,t} = \beta_0 + \beta_1 r_{m,t-2} + \beta_2 r_{m,t-1} + \beta_3 r_{m,t} + \beta_4 r_{m,t+1} + \beta_5 r_{m,t+2} + \varepsilon_{i,t} \quad (1)$$

In the equation (1), $r_{i,t}$ Ignifies the return on stock *i* during week *t*. $r_{m,t}$Represents the market return in week *t*. Subsequently, we determined the firm-specific weekly return ($W_{i,t}$), Using the natural logarithm of 1 added to the regression residual: $W_{i,t} = \text{Log}(1 + \varepsilon_{i,t})$.

Negative skewness (NCSKEW) is calculated by taking the sign of the third moment of firm weekly returns for each sample year and dividing that by the standard deviation of the weekly returns raised to the third power, as per the method laid out in the studies by Kim, Li, and Zhang, (2011) and Shahab et al., (2020). The formula is shown below:

$$NCSKEW_{i,t} = -\frac{[\text{n}(\text{n}-1)^{3/2} \ \sum W_{i,t}^{3}]}{[\ (n-1)(n-2)(\sum W_{i,t}^{2})^{\frac{3}{2}}\ ]} \qquad (2)$$

The down-to-up volatility (DUVOL), as described in the works of Kim, Li, and Zhang (2011) and Shahab et al. (2020), is determined by sorting the weeks into two categories: those where the firm-specific weekly returns fall below the annual average (termed as down weeks) and those where the returns exceed the average for the period (termed as up weeks). The standard deviation is then calculated for each of these categorised sets separately. The final DUVOL measure is calculated by taking the natural log of the ratio of the standard deviation of down weeks to the standard deviation of up weeks, as shown:

$$Duvol_{i,t} = \log\frac{[\,(n_u-1)\ \sum_{Down} w_{i,t}^{2}]}{[\,(n_d-1)\ \sum_{Up} w_{i,t}^{2}]} \qquad (3)$$

A greater value of NCSKEW/DUVOL shows a return distribution that tends more to the left skewed, indicating that the company has a greater stock price crash risk.

c. Main independent variable: CEO power

The concept of CEO power, as per Liu and Jiraporn (2010), remains a challenge for direct observation. Thus, scholars have put extensive effort into identifying more tangible proxies, measures, or indicators that could capture it (Salancik & Pfeffer, 1974; Pfeffer, 1981; Provan, 1980). In this study, the primary proxy employed to represent CEO power is the CEO Pay Slice (CPS), capturing the CEO's total compensation relative to the top five earning executives, including the CEO. It captures the CEO's comparative importance within the management company, reflecting their contribution, authority, and ability. The employment of CPS as a representation of CEO power has been widely employed by the literature, such as Vo and Canil (2019) and Liu and Jiraporn (2010), among others. The proxy has been claimed to be a more objective measure relative to others, consideration of its capacity to explain "the relative centrality of the CEO in the top management team" (Liu & Jiraporn, 2010, p. 748; Finkelstein, 1992), and its strong explanatory ability regarding a company's corporate outcomes (Bebchuk et al., 2009). Additionally, CPS was built using the compensation data of executive directors within the same firm, hence offering a control for firm-specific characteristics (Bebchuk et al., 2009).

Utilising the established approach in the literature, the CEO pay slice (CPS) is computed as the percentage of a CEO's total compensation to the higher compensation of the top five executives in each firm. The calculation is expressed as follows:

$$CPS = \frac{CEO\ total\ compensation}{\sum Top\!-\!five\ executives'\ compensations\ (including\ CEO)} \qquad (4)$$

d. *Environmental practices: GHG emissions and SDG-13 climate change*

To capture the environmental practices of firms, we employ measures of GHG emission levels and whether firms support Sustainable Development Goal 13 (SDG-13), which are obtained from the Refivitiv database. For GHG emission levels, we use the CO2 Equivalent Emissions Direct, Scope 1 category (measured in tones: $GHG = (GHG_t - GHG_{t-1})/GHG_{t-1}$). It refers to the direct emissions of carbon dioxide (CO2) and CO2 equivalents measured in tones. Refinitiv defines these emissions as stemming from company-owned or controlled sources. The gases considered relevant in this context include emissions from combustion in owned or controlled boilers, furnaces, and vehicles and chemical production in owned or controlled process equipment. Regarding the SDG-13 variable, we construct a dummy specifying whether a Firm supports the United Nations (UN) Sustainable Development Goal 13 (SDG 13) to take urgent action to tackle climate change and its impacts (Dummy variable codes as one if a firm supports SDG-13 in its sustainability report and zero otherwise).

e. *Controlling variables variables definition*

This study controls for three groups of variables, as done in previous research (e.g., Kim, Liao, and Liu, 2022; Fan et al., 2021; Shehzad et al., 2020; and more[6]). The first group contains firm characteristics such as size, sales growth, profitability, R&D spending, growth opportunities, Intangibility, leverage, dividend cuts, cash surplus, Quick Ratio, and Z-score. Furthermore, the weekly standard deviation for returns (SIGMA) is also controlled due to their vulnerability and sensitivity to crashes (Kim et al., 2022). Chen et al. (2001) and Kim, Liao, and Liu (2022)

[6] (see Yung & Chen, 2017; Sila et al., 2016; Bastos & Pindado, 2013; Coles et al., 2006 Hertzel, Huson, and Parrino, 2012; Bartram, Brown, and Conrad, 2011; Altman, 1983; Altman et al., 2017; Lewellyn and Muller-Kahle, 2012)

suggested that past high returns contribute to future crashes. Hence, past returns (RET) are included. Second, it controls for CEO and board characteristics such as board size, female representation, Board independence, CEO age, gender, duality, tenure, and education, following studies such as (Coles et al., 2006; Fan et al., 2021; Lewellyn & Muller-Kahle, 2012). Given the international data comprising G7 firms, our model also controls for macroeconomic factors such as GDP growth, inflation, foreign investment, stock market volatility, stock market capitalisation to GDP, private credit by deposit money banks to GDP, investor protection index, financial crises, and the COVID-19 pandemic dummies. For more details, Table 1 provides the definitions and computations of all employed control variables.

TABLE 1: DEFINITIONS, MEASURES OF VARIABLES, AND DATA SOURCE		
Panel A: Dependent variables (Crash risk)[7]		
NCSKEW	The negative skewness risk (in Eq. (1))	Refinitiv
DUVOL	The down-to-up volatility (in Eq. (2))	Refinitiv
Panel B: Independent variables (CEO power)[8]		
CEO Pay Slice	Measured as presenting of total compensation relative to the highest executives five including CEO (in Eq. (3))	WRDS Boardex
Panel C: Control variables (Firm characteristics)[9]		
Firm size (SIZE)	Firm total asset = ln (TA)	Refinitiv DataStream
Sales Growth (Growth)	The annual growth rate in sales= $\ln(\frac{\text{Sale}_T}{\text{Sale}_{T-1}})$	Refinitiv DataStream
Profitability (Profit)	Corporate earnings = $\frac{\text{Earnings before interest,tax,depreciation,amortisation}}{\text{Total asset}}$	Refinitiv DataStream
R&D expense (R&D%)	% Research and development expense to total asset = $\frac{\text{R\&D expense}}{\text{Total asset}}$	Refinitiv DataStream
Intangibility	= (intangible asset/total asset)	Refinitiv DataStream
Quick Ratio (Quickratio)	= (Cash & Equivalents + Receivables (Net)) / Current Liabilities	Refinitiv DataStream
Market leverage (Leverage)	% of debt financing to firm market value = $\frac{\text{Short-term debt+Long-term debt}}{\text{Total assets − Book equity + market equity}}$	Refinitiv DataStream
Surplus cash (Cash_surp)	% surplus cash to total asset = $\frac{\text{Operating net cash flow−Depreciation and Amortisation+R\&D expense}}{\text{Total Assets}}$	Refinitiv DataStream
Dividend cut (Div_cut)	A dummy variable that takes the value of one if there is a decrease in the annual dividend pay-out, and zero otherwise.	Refinitiv DataStream

[7] Gu et al., 2022; and Shahab et al., 2020

[8] Bebchuk et al., 2009

[9] Yung and Chen, 2017; Coles et al. 2006; Kim, Liao, and Liu, 2022, Hertzel, Huson, and Parrino, 2012; Bartram, Brown, and Conrad, 2011; Altman, 1983; Altman et al., 2017.

Z_score	$= \frac{(3.3 * \text{EBIT}) + (1 * \text{Net sales}) + (1.4 * \text{Retained earning}) + (1.2 * (\text{Working Capital}))}{\text{Total Asset}}$	Refinitiv DataStream
Return (RET)	The average weekly return specific to a firm over the fiscal year.	Refinitiv DataStream
SIGMA	The standard deviation of the weekly return specific to a firm over the fiscal year.	Refinitiv DataStream
Panel D: Control variables (Board characteristics)[10]		
Board size (Board_size)	Number of directors on the firm board of directors	WRDS Boardex
Female representation (%female)	The fraction of female directors on board	WRDS Boardex
Board independence (Board)	$(\%) = \frac{\text{Number of independent board directors}}{\text{Board size}}$	WRDS Boardex
Panel E: Control variables (CEO characteristics)[11]		
CEO age (CEO_Age)	The biological age of the CEO (in years)	WRDS Boardex
CEO tenure (CEO_Tenure)	Number of years that the CEO has been holding their positions	WRDS Boardex
CEO gender (CEO_fem)	The dummy variable takes the value of unity if the CEO is female and zero; otherwise.	WRDS Boardex
CEO duality (CEO_duality)	dummy variable equal to 1 if the same person holds a firm's CEO and chairperson roles, and 0 otherwise	WRDS Boardex
CEO Education (PhH_holder &	The dummy variable takes the value of unity if the CEO has a master or above and zero otherwise.	WRDS Boardex
Panel F: Control variables (Others)[12]		

[10] Yung and Chen, 2017; Sila et al. 2016; Lewellyn and Muller-Kahle, 2012
[11] Coles et al., 2006; Fan et al., 2021; Lewellyn and Muller-Kahle, 2012
[12] Bastos, and Pindado, 2013; Shehzad et al., 2020

Financial crisis (Crisis_F)	The dummy variable takes the value of one if the firm-year observations fall within the global financial crisis period 2007-2009 and zero otherwise.	
Covid crisis (Crisis_C)	The dummy variable takes the value of one if the firm-year observations fall in the COVID-19 crisis period 2020-2021 and zero otherwise.	
ES score	Environmental and Social scores are measured by averaging the two categories. Refinitiv assigns each company an E and S score of 0 to 100.	Refinitiv DataStream
Panel G: Moderator variables [13]		
GHG emission (GHG)	The greenhouse gas emission intensity is calculated by taking the yearly percentage change in scope 1, i.e., direct carbon dioxide emissions and CO2 equivalents measured in tones.	Refinitiv DataStream
SDG 13 (SDG13)	Dummy variable codes as one if a firm supports SDG-13 in its sustainability report and zero otherwise	Refinitiv DataStream
Panel F: Control variables (Country level)		
Annual GDP growth rate (GDP_ Growth)	measures the percentage growth in GDP for each country	World bank
Annual inflation rate (Inflation_Rate)	is the percentage annual change in the consumer price index (CPI) of each country	World bank
Foreign direct investment (Foreign_investment)	measures foreign direct investment as a percentage of GDP for each country	World bank
Stock market volatility (Mrk_stk_volatilit)	Stock price volatility is the average 360-day national stock market index volatility.	World bank
Stock market capitalisation to GDP	Total value of all listed shares in a stock market as a percentage of GDP.	World bank
Private credit by deposit money banks to GDP	Private credit by deposit money banks and other financial institutions to GDP	World bank
Investor protection index (Investor_protection)	The Protecting Investors Disclosure Index measures the degree to which investors are protected by disclosing ownership and financial information.	World bank

[13] Drempetic et al., 2020; Shakil, 2022

f. Estimation models

To empirically test the hypotheses, we employ the Ordinary Least Squares (OLS) regression with firm-clustered standard errors as the baseline method at the firm-specific level. We specify the following regressions that will be estimated:

$$NCSKEW_{i,t} / DUVOL_{i,t} = \alpha_{i,t} + \beta_1\, CPS_{i,t} + \beta_2\, CPS\_GHG_{i,t} + \beta_3\, GHG_{i,t} + \beta_4\, CPS\_SDG13_{i,t} + \beta_5\, SDG13_{i,t} + \beta X_{i,t} + (Year,\ Industry,\ Country).FE + \epsilon_{i,t} \tag{5}$$

The model presented in (eq.5) is designed to examine the relationship between CEO power and firm stock price crash risk, denoted by the coefficient β_1; and the moderating effects of environmental practices on such relationship, denoted by β_2 and β_4 for GHG level and SDG-13 support, respectively. The dependent variables capture the negative skewness risk and down-to-up volatility of the firm i for year t ($NCSKEW_{i,t}$ and $DUVOL_{i,t}$, respectively). The key independent variable is the CEO pay slice (CPS), representing CEO power. The greenhouse gas emissions (GHG) and Sustainable Development Goal 13 (SDG-13) are environmental moderators in the relationship between CEO power and firm stock price crash, represented by the interaction terms CPS_GHG and CPS_SDG13, respectively. The regression includes control variables ($X_{i,t}$) as explained in Section 4.c, and considers the year, industry, and country fixed effect. The clustered standard error addresses heteroskedasticity and autocorrelation issues (Abadie et al., 2022; White, 1980). Furthermore, the study employs several models to address endogeneity concerns, including the additional Variables, fixed/random effect, GMM, 2SLS, lagged dependent variable, and weighted Least Square (WLS). Additionally, we employ other measures of CEO power to validate the findings.

5. EMPIRICAL FINDINGS

a. Descriptive statistics and pair-wise correlation matrix

Table 2 illustrates descriptive statistics for all variables of the full sample. The down-to-up volatility (DUVOL) and the negative skewness risk (NCSKEW) have averages of 0.017 and 0.202. For the main independent variable (CPS), CEOs receive approximately 25% of the total compensation of the top five executives on average. This percentage indicates CEOs are typically the highest payee among their firm's executives. This result confirms Li et al. (2018) conclusion about CEOs' compensations. Regarding moderators, average GHG emissions and SDG-13 are 0.018 and 0.006, respectively. These metrics indicate a company's commitment to sustainability, providing a view of a company's environmental impact. Regarding controls, the average CEO age was 63, ranging from 41 to 85. Female CEOs represented around 5% of observations. The average tenure was 1.3 years, with a median of 1.20, ranging from new appointments (less than one year) to 3 years maximum. The average CEO duality (CEOs who also occupy Chairman positions) is 35.5%. Over half of the CEOs received at least a master's degree (mean Master_holder was 53.5%), and around 15 % received a PhD.

The firm characteristics in the employed sample recorded an average company size of 12.425, measured by the total asset logarithm. The smallest company recorded 5.7 log total assets, and the largest recorded 18.6 log total assets. The average sales growth rate was around 15% annually, while the median annual growth rate was approximately 9%. In terms of profitability, the average was around -9%, whereas the median profitability was 5%. For research and development spending, the sample companies allocated, on average, 13% of total assets towards R&D projects per year. Moving to leverage, defined as debt over assets, the full sample recorded an average of 15.5% and a median of approximately 10%, with individual firms ranging from 0% (for those without leverage) to as high as 74.5%. The average cash surplus was 25% of assets overall, with a median of around 15%. Based on the data, dividend cuts were captured using an indicator variable equal to 1 if the company lowered its annual dividend payout or 0 if it did not. The mean for this measure was 16.7%, meaning 16.7% of firm-years in the sample showed a dividend reduction over one year. However, the median was 0%, which indicates that companies are typically very conservative in cutting dividends due to the potential effects and sensitivity in financial markets. Regarding stock volatility and return (Sigma and RETURN), the mean was 0.035 and 0.069, respectively. Sigma and year return are fundamental for assessing a company's financial stability.

Regarding the board composition, companies appointed an average of 8 directors to their boards, with a median number of 7. The data showed that the female representation was 10.7%, and the median was about 8%, reflecting the overall proportion of women directors. The reported average board independence of the proportion of board members was approximately 58%. Regarding the global financial crisis (Crisis_F), a dummy variable was used with a value of 1 if the firm-year observations were between 2007-2009 or 0 otherwise. The total number of observations was 49,256, including 19% of the sample. For the global health crisis, the COVID variable (Crisis_C) was used as a dummy variable with a value of 1 if the firm-year observations were 2020-2021; otherwise, 0. The data showed that the total number of observations was 32,912, including 13% of the sample.

Table 2: Variable Descriptive Statistics for Full Sample

Table 2 provides the descriptive statistics of all variables employed in the study. Definitions and measurements for variables in the Table 2 are provided in Table 1.

Variable	N	Mean	p50	Std.Dev	Min	Max
DUVOL	250,311	0.017	0.004	0.393	-1.23	1.388
NSKEW	250,311	0.202	0.063	1.995	-6.52	8.339
CPS	75,537	0.241	0.222	0.137	0	0.75
GHG	36,116	0.018	0.000	0.233	-0.605	1.5
SDG13	263,548	0.006	0.000	0.075	0	1
CEO_Age	252,493	63.456	63.800	9.023	41	85.111
CEO_ female	119,806	0.049	0.000	0.215	0	1
PhD_holder	99,867	0.145	0.000	0.352	0	1
Master_holder	99,867	0.535	1.000	0.499	0	1
CEO_Tenure	263,532	1.287	1.194	0.746	0	3.199
CEO_duality	119,806	0.355	0.000	0.479	0	1
Board_size	239,020	8.04	7.333	3.102	3	18.571
Board	263,532	0.576	0.615	0.248	0	1
% Female	263,532	0.107	0.083	0.121	0	.5
Cash_surp	127,024	0.25	0.149	0.283	-0.119	0.961
Sigma	194,559	0.035	0.029	0.023	0	0.132
RETURN	106,454	0.069	0.013	0.439	-0.638	1.177
SIZE	239,488	12.435	12.473	2.603	5.681	18.553
Growth	222,624	0.145	0.088	0.44	-1.222	2.19
Profit	232,304	-.088	0.048	0.504	-3.315	0.417
R&D %	128,272	0.133	0.030	0.27	0	1.797
Leverage	237,264	0.155	0.099	0.172	0	0.745
Div_cut	136,902	0.167	0.000	0.373	0	1
Crisis_F	263,532	0.187	0.000	0.39	0	1
Crisis_C	263,532	0.125	0.000	0.331	0	1
GDP_ Growth	119,548	1.052	1.880	2.62	-9.396	6.869
Inflation_Rate	119,548	1.785	1.850	0.955	-2.312	5.348
Foreign_investment	119,548	2.275	1.761	1.987	-1.17	11.929

b. Pairwise correlations matrix

Table 3 illustrates the Pearson correlation matrix between the employed independent variables. As reported in the data, the strongest correlated pair is size and board size (0.675). This means that larger companies tend to have larger boards. The reported R&D% and profitability was -0.652. As the percentage of revenue spent on Research and Development (R&D) increases, profitability is likely to decrease, and vice versa. This could suggest that higher R&D spending (as a percentage of revenue) might not immediately yield higher profitability. Sharma (2005) suggests that correlation values over 0.8 indicate potential multicollinearity issues in the data. Since the highest correlation in the current study is below this 0.8 threshold, multicollinearity does not necessarily represent a significant concern. Additionally, variance inflation factor (VIF) tests were run to conduct the regressions. All VIF values scored under 10, confirming that multicollinearity does not significantly impact the employed dataset.

Table 3: Correlation matrix

Table 3 presents the correlation matrix of all employed variables. Definitions and measurements for variables in the Table are provided in Table 1. Bold coefficients signify statistically significant correlations at the 5% critical level or below.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
(1) CPS	1												
(2) GHG	-0.008	1											
(3) SDG13	**0.012**	**-0.015**	1										
(4) CEO_Age	**-0.008**	0.008	**-0.014**	1									
(5) CEO_ female	**-0.071**	-0.007	**0.016**	**-0.086**	1								
(6) PhH_holder	**0.039**	-0.003	-0.005	**0.056**	**0.006**	1							
(7) Master_holder	**0.058**	0.009	**-0.006**	**0.019**	0.004	**0.391**	1						
(8) CEO_Tenure	**0.075**	0.001	**0.014**	**0.317**	**-0.049**	**0.023**	**-0.013**	1					
(9) CEO_duality	**0.167**	-0.008	**-0.017**	**0.259**	**-0.102**	**0.069**	**0.038**	**0.145**	1				
(10) Board_size	**0.213**	**0.022**	**0.055**	**0.194**	**-0.025**	**0.02**	**0.052**	**0.069**	**0.089**	1			
(11) Board	**0.01**	0	**-0.018**	**-0.015**	**0.035**	**0.007**	**0.106**	**0.005**	**-0.023**	**0.031**	1		
(12) % Female	**0.034**	-0.002	**0.06**	**-0.168**	**0.295**	**-0.01**	**0.03**	**-0.046**	**0.006**	**0.203**	**0.132**	1	
(13) Cash_surp	-0.002	-0.008	**-0.039**	**-0.205**	**0.017**	**0.215**	**0.126**	**-0.148**	**-0.072**	**-0.206**	**0.201**	**0.023**	1
(14) Sigma	**-0.029**	**-0.028**	**-0.035**	**-0.121**	0.005	**0.065**	**0.027**	**-0.126**	**-0.047**	**-0.306**	**0.026**	**-0.119**	**0.253**
(15) RETURN	**0.021**	-0.002	0	**0.007**	**-0.011**	0.003	0.005	**0.045**	**0.016**	**0.006**	**0.013**	-0.001	0.002
(16) SIZE	**0.157**	**0.042**	**0.085**	**0.179**	**-0.006**	**-0.031**	**0.033**	**0.113**	**0.084**	**0.675**	**0.138**	**0.205**	**-0.342**
(17) Growth	**-0.029**	**0.04**	**-0.023**	**-0.1**	**-0.011**	**0.026**	**0.01**	**-0.118**	0	**-0.097**	**-0.006**	**-0.03**	**0.138**
(18) Profit	**0.028**	**0.009**	**0.025**	**0.121**	**-0.006**	**-0.107**	**-0.045**	**0.163**	**0.057**	**0.222**	**-0.015**	**0.05**	**-0.35**
(19) R&D %	**-0.034**	-0.006	**-0.031**	**-0.122**	**0.014**	**0.188**	**0.108**	**-0.148**	**-0.069**	**-0.184**	**0.137**	**0.019**	**0.449**
(20) Leverage	**0.025**	-0.002	**0.024**	**0.07**	**-0.022**	**-0.047**	**-0.023**	**0.044**	**0.044**	**0.142**	**-0.028**	0.003	**-0.44**
(21) Div_cut	**-0.026**	**-0.026**	**0.076**	**0.015**	**0.037**	**-0.05**	**-0.048**	**0.042**	**-0.014**	**0.084**	**-0.047**	**0.083**	**-0.146**
(22) Crisis_F	**-0.01**	**-0.013**	**-0.026**	**0.023**	**-0.021**	-0.001	**-0.007**	**-0.006**	**0.015**	0.002	**-0.014**	**-0.034**	0.001
(23) Crisis_C	0.005	-0.007	**0.159**	**-0.047**	**0.05**	-0.003	0.003	0.003	**-0.04**	**-0.014**	**0.02**	**0.062**	0.005
(24) GDP_ Growth	**0.043**	**0.05**	**-0.173**	**0.163**	**-0.057**	**0.017**	**0.025**	**0.018**	**0.049**	**0.071**	**0.023**	**-0.159**	**-0.009**
(25) Inflation_Rate	**-0.064**	-0.001	**0.031**	**0.112**	**0.034**	**-0.01**	**-0.016**	**-0.027**	0.002	**-0.07**	**-0.05**	**-0.069**	0.001
(26) Foreign_investme	**-0.13**	0.011	**-0.034**	**0.061**	**0.007**	**-0.039**	**-0.07**	**-0.043**	**-0.104**	**-0.152**	**-0.19**	**-0.127**	**-0.046**

	14	15	16	17	18	19	20	21	22	23	24	25	26
(14) Sigma	1												
(15) RETURN	**-0.059**	1											

(16) SIZE	**-0.486**	**0.013**	1										
(17) Growth	**0.029**	**0.046**	**-0.12**	1									
(18) Profit	**-0.421**	**0.111**	**0.468**	**-0.075**	1								
(19) R&D %	**0.317**	**-0.069**	**-0.388**	**0.071**	**-0.652**	1							
(20) Leverage	**-0.059**	**-0.116**	**0.327**	**-0.066**	**0.147**	**-0.209**	1						
(21) Div_cut	**-0.1**	-0.004	**0.162**	**-0.135**	**0.098**	**-0.116**	**0.114**	1					
(22) Crisis_F	**0.079**	**-0.087**	**-0.012**	**-0.01**	**-0.007**	**0.009**	**0.015**	**0.023**	1				
(23) Crisis_C	**0.035**	**0.011**	**0.034**	**-0.025**	**0.004**	**-0.019**	**0.012**	**0.062**	**-0.129**	1			
(24) GDP_ Growth	**-0.225**	**-0.046**	**0.033**	**0.125**	**0.041**	-0.003	**-0.033**	**-0.169**	**-0.275**	**-0.755**	1		
(25) Inflation_Rate	**-0.027**	**-0.083**	**-0.119**	**0.095**	**0.009**	0.005	**-0.043**	**-0.054**	**0.007**	**0.053**	0.001	1	
(26) Foreign_investme	**0.018**	**-0.131**	**-0.146**	**0.058**	**-0.028**	0	**-0.038**	**-0.03**	**0.139**	**-0.157**	**0.197**	**0.156**	1

c. *Main findings: Baseline OLS cluster estimation*

i. *CEO power and firm stock price crash risk: Baseline OLS cluster at firm level.*

Using the Ordinary Least Squares (OLS) with clustered standard error at the firm level, the results for the baseline estimation models (eq.5) are reported in Table 4. The results with DUVOL and NCSKEW as the crash risk measures are shown in Panel A (columns 1-5) and Panel B (columns 6-10), respectively. We run five model variations to ensure the consistency of the findings. The first variation model is the full model (eq.5) without interaction terms related to environmental practices and without dummy fixed effects. The second variation model is the same as the first variation but further controls for the year, industry, and country fixed effects. These first two variations can explain the relationship between CEO power and stock price crash risk, i.e., the H1. From the third model onward, moderating factors are gradually included with interaction terms employed to test for H2. The third model variation includes GHG emission as a moderator, i.e., variables CPS_GHG and GHG. The fourth model includes SDG-13 as a moderator instead of the GHG level, i.e., variables CPS_SDG13 and SDG13. The last variation model is the full model, and it includes all variables, as explained in eq.5, with both moderators included.

Across the five model variations, the adjusted R-squared increases and the highest value are obtained for the last full model (Column 5, Panel A (DUVOL), and Column 10, Panel B (NSCKEW)). This indicates the highest goodness-of-fit for the full model presented in eq.5. The results across the five variations show consistent findings for H1 and H2 based on the coefficients of CPS (β_1, test for H1) and of CPS_GHG and CPS_SDG13 (β_2 and β_4, respectively, test for H2). Particularly, coefficient β_1 consistently reveals negative values, which are statistically significant at the 10% level or below for both measures of crash risk. This indicates the negative relationship between CEO power and crash risk, supporting hypothesis 1. Specifically, based on the β_1 of the last module variation ($\beta_1 = -0.078$ & -0.324, column 5 and column 10, respectively), the results indicate that for every one percent increase in CEO power (measured by a one percent increase in the CEO's pay, relative to the total pay of the top five directors), stock price crash risk measured by DUVOL is reduced by 8% and by NSCKEW is reduced by 32%. Our finding is consistent with the agency theory view on the risk-averse nature of CEOs. CEOs with higher power would ratinsteadeir status quo (including their empowerment privilege) by avoiding withholding negative news. Such cautious information disclosure can minimise the risk of legal repercussions, as well as the employment and reputational risk of CEOs (Kasznik and Lev, 1995; Skinner, 1997).

Regarding the second hypothesis (H2), the interaction term coefficients between CPS × GHG emission (CPS_GHG) were not statistically significant. This signifies that the level of GHG emissions does not influence the relationship between CEO power and crash risk. In other words, the effect of CEO power in reducing crash risk is *independent* of the GHG emission level of firms. Nevertheless, firms' decisions on whether or not to support SDG13 regarding climate change action show a significant impact. Specifically, the coefficients of CPS_SDG13 (β_4) are negative and statistically significant at the 5% level for both DUVOL and NCSKEW measures. This supports the H2 that for firms that support the climate change action SDG-13, the negative relationship between CEO power and crash risk becomes stronger compared to firms that do not support the SDG-13. The finding supports the view that the support of SDG-13 signifies firms' solid environmental practices. Since such decisions are often made and approved by CEOs, they signify the ethicality of the executive in leading their firms. Consequently, those so-called ethical CEOs are less likely to use their power to conceal bad news for their self-interest, leading to a stronger *negative* impact of CEO power on crash risk.

The specific focus of each factor may explain the difference in the moderating effects of GHG emissions and SDG-13. GHG emissions predominantly address environmental impact, specifically greenhouse gas emissions, offering a narrower lens for evaluating a firm commitment to environmental sustainability. On the other hand, SDG-13 covers a broader spectrum. Specifically, the "Climate Action" SDG-13 is embedded within the United Nations' global goals for sustainable development. The goal comprises various targets and indicators to foster environmental sustainability, resilience, and responsible practices[14]. By supporting SDG-13, firms commit not only to mitigating the impacts of climate change but also to actively contributing to global efforts to reduce GHG emissions, improve climate resilience, and foster sustainable development. The goals outlined in SDG-13 are not confined solely to environmental concerns but extend to broader socio-economic aspects, acknowledging the interconnectedness of climate action with poverty alleviation, economic growth, and social equity. Compared to the GHG emission level, the stronger coverage of SDG-13 is significant enough to suggest that firms actively supporting SDG-13 are more likely to manifest ethical solid leadership, as reflected in the CEO's decision-making processes. This ethical orientation,

[14] https://www.globalgoals.org/goals/13-climate-action/

tied to climate action and sustainability, reduces CEOs' inclination to exploit their power for self-interest, thus contributing to a lower crash risk.

Regarding control variables, the analysis shows that CEO age, return, and leverage negatively affect firm crash risk. In contrast, it is positively affected by the representation of female directors on board, sigma, and size. These findings are consistent with the literature (Kim et al., 2016, Kim, Liao, and Liu, 2022; Andreou et al., 2016).

Table 4: Influences of CEO power on firm crash risk and moderations: The baseline estimation model

Table 4 presents the results of the estimation of baseline methods (OLS) with clustered standard error at the firm level from 2006 through to 2021. Definitions and measurements for variables in the Table are provided in Table 1. Standard errors are presented in parentheses. ***, **, and * indicate significance levels at 1%, 5%, and 10% critical levels, respectively.

	Panel A: DUVOL					**Panel B: NSKEW**				
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CPS	***-0.072*****	***-0.073*****	***-0.088*****	***-0.068****	***-0.078*****	***-0.346*****	***-0.395*****	***-0.371*****	***-0.371****	***-0.324****
	(0.033)	***(0.036)***	***(0.036)***	***(-1.861)***	***(0.036)***	***(0.170)***	***(0.189)***	***(0.186)***	***(-1.937)***	***(0.188)***
CPS_GHG	**-**	**-**	***-0.033***	**-**	***-0.047***	**-**	**-**	***-0.232***	**-**	***-0.304***
	-	**-**	***(0.103)***	**-**	***(0.104)***	**-**	**-**	***(0.479)***	**-**	***(0.480)***
GHG	-	-	0.025	-	0.029	-	-	0.097	-	0.115
	-	-	(0.030)	-	(0.030)	-	-	(0.143)	-	(0.143)
CPS_ SDG13	**-**	**-**	**-**	***-0.251******	***-0.205*****	**-**	**-**	**-**	***-1.118*****	***-1.093*****
	-	**-**	**-**	***(-2.669)***	***(0.090)***	**-**	**-**	**-**	***(-2.539)***	***(0.426)***
SDG13	-	-	-	0.047	0.044	-	-	-	0.207	0.330
	-	-	-	(1.104)	(0.041)	-	-	-	(0.966)	(0.208)
CEO_Age	-0.003***	-0.002***	-0.001	-0.002***	-0.001	-0.012***	-0.011***	-0.006*	-0.011***	-0.006*
	(0.001)	(0.001)	(0.001)	(-3.282)	(0.001)	(0.003)	(0.003)	(0.004)	(-3.287)	(0.003)
CEO_ female	0.007	0.020	0.026	0.019	0.026	0.066	0.109	0.120	0.106	0.119
	(0.018)	(0.017)	(0.016)	(1.114)	(0.016)	(0.089)	(0.089)	(0.079)	(1.189)	(0.079)
PhH_holder	-0.006	-0.004	-0.005	-0.004	-0.005	-0.018	-0.012	-0.009	-0.012	-0.009
	(0.013)	(0.013)	(0.013)	(-0.327)	(0.013)	(0.066)	(0.066)	(0.064)	(-0.183)	(0.064)
Master_holder	0.002	-0.003	0.009	-0.003	0.009	-0.004	-0.013	0.029	-0.013	0.029
	(0.009)	(0.009)	(0.008)	(-0.340)	(0.008)	(0.045)	(0.046)	(0.044)	(-0.288)	(0.043)
CEO_Tenure	0.000	-0.000	0.003	-0.000	0.003	-0.003	0.005	0.020	0.006	0.021
	(0.006)	(0.006)	(0.006)	(-0.013)	(0.006)	(0.031)	(0.030)	(0.029)	(0.181)	(0.029)
CEO_duality	-0.006	-0.014	-0.001	-0.014	-0.001	-0.058	-0.092*	-0.033	-0.091*	-0.033
	(0.009)	(0.009)	(0.009)	(-1.550)	(0.009)	(0.046)	(0.047)	(0.044)	(-1.947)	(0.044)
Board_size	0.0004	-0.003	-0.002	-0.003	-0.002	0.001	-0.015*	-0.003	-0.014*	-0.003
	(0.002)	(0.002)	(0.002)	(-1.473)	(0.002)	(0.008)	(0.009)	(0.008)	(-1.672)	(0.008)
Board_ independent	0.040	0.021	0.045	0.021	0.044	0.275*	0.228	0.407**	0.228	0.401**
	(0.030)	(0.034)	(0.030)	(0.612)	(0.030)	(0.162)	(0.181)	(0.183)	(1.255)	(0.183)
% Female	0.129***	0.084*	0.004	0.087*	0.007	0.281	0.199	0.035	0.213	0.041
	(0.042)	(0.046)	(0.045)	(1.903)	(0.045)	(0.216)	(0.233)	(0.238)	(0.915)	(0.237)
Cash_surp	-0.016	-0.030	0.007	-0.029	0.007	-0.084	-0.156	0.003	-0.155	0.001
	(0.032)	(0.033)	(0.032)	(-0.903)	(0.032)	(0.161)	(0.163)	(0.173)	(-0.955)	(0.173)
Sigma	1.228**	1.580***	4.381***	1.573***	4.364***	5.500**	8.173***	29.759***	8.141***	29.784***
	(0.535)	(0.558)	(0.925)	(2.821)	(0.926)	(2.511)	(2.687)	(6.287)	(3.029)	(6.303)
RETURN	-0.485***	-0.530***	-0.512***	-0.530***	-0.513***	-1.877***	-2.119***	-2.187***	-2.120***	-2.188***
	(0.013)	(0.015)	(0.019)	(-35.595)	(0.019)	(0.066)	(0.076)	(0.100)	(-27.880)	(0.100)

SIZE	0.013***	0.010***	0.006*	0.010***	0.006*	0.038**	0.038*	0.010	0.038*	0.010
	(0.004)	(0.004)	(0.003)	(2.630)	(0.003)	(0.018)	(0.020)	(0.018)	(1.892)	(0.018)
Growth	-0.002	0.011	0.061***	0.011	0.061***	-0.052	0.013	0.269**	0.013	0.266**
	(0.016)	(0.016)	(0.022)	(0.680)	(0.022)	(0.079)	(0.080)	(0.130)	(0.165)	(0.130)
Profit	0.010	0.024	0.185***	0.024	0.185***	0.220	0.280*	0.923***	0.280*	0.921***
	(0.026)	(0.027)	(0.047)	(0.904)	(0.047)	(0.140)	(0.143)	(0.239)	(1.950)	(0.239)
R&D %	-0.044	-0.060	-0.031	-0.060	-0.030	-0.181	-0.300	-0.153	-0.300	-0.153
	(0.057)	(0.058)	(0.078)	(-1.040)	(0.078)	(0.309)	(0.311)	(0.428)	(-0.965)	(0.428)
Leverage	-0.090*	-0.102**	-0.045	-0.103**	-0.046	-0.457**	-0.471*	-0.317	-0.473*	-0.331
	(0.047)	(0.049)	(0.048)	(-2.078)	(0.048)	(0.233)	(0.243)	(0.252)	(-1.944)	(0.252)
Div cut	0.009	0.009	-0.001	0.010	-0.001	0.105*	0.086	0.040	0.088	0.040
	(0.010)	(0.010)	(0.011)	(0.935)	(0.011)	(0.055)	(0.056)	(0.062)	(1.574)	(0.062)
Crisis F	-0.029**	0.013	0.040	0.008	0.036	-0.132**	-0.312	-0.270	-0.335	-0.283
	(0.013)	(0.058)	(0.057)	(0.141)	(0.058)	(0.067)	(0.301)	(0.289)	(-1.102)	(0.291)
Crisis_C	-0.087***	-0.023	0.023	-0.025	0.020	-0.362***	-0.567	-0.389	-0.578	-0.401
	(0.026)	(0.068)	(0.064)	(-0.369)	(0.064)	(0.129)	(0.353)	(0.321)	(-1.635)	(0.322)
GDP Growth	-0.008***	-0.009	-0.004	-0.009	-0.005	-0.025*	-0.063*	-0.039	-0.067*	-0.040
	(0.003)	(0.007)	(0.007)	(-1.253)	(0.007)	(0.015)	(0.038)	(0.035)	(-1.746)	(0.035)
Inflation Rate	-0.008	-0.016*	-0.008	-0.018*	-0.009	-0.022	-0.101**	-0.085*	-0.105**	-0.095*
	(0.005)	(0.010)	(0.010)	(-1.815)	(0.010)	(0.025)	(0.050)	(0.049)	(-2.089)	(0.050)
Foreign_investment	-0.004**	0.003	-0.006***	0.003	-0.006**	-0.019*	0.008	-0.028**	0.010	-0.026**
	(0.002)	(0.003)	(0.002)	(1.165)	(0.002)	(0.010)	(0.014)	(0.013)	(0.693)	(0.013)
Constant	0.066	0.083	-0.027	0.085	-0.025	0.661**	1.000***	0.406	1.011***	0.424
	(0.054)	(0.072)	(0.081)	(1.187)	(0.081)	(0.287)	(0.386)	(0.442)	(2.610)	(0.444)
Year fixed effect	NO	Yes	Yes	Yes	Yes	NO	Yes	Yes	Yes	Yes
Firm fixed effect	NO	Yes	Yes	Yes	Yes	NO	Yes	Yes	Yes	Yes
Industry fixed effect	NO	Yes	Yes	Yes	Yes	NO	Yes	Yes	Yes	Yes
Country fixed effect	NO	Yes	Yes	Yes	Yes	NO	Yes	Yes	Yes	Yes
Observations	11,189	11,189	6,708	11,189	6,708	11,189	11,189	6,708	11,189	6,708
R-squared	0.207	0.222	0.244	0.222	0.244	0.123	0.138	0.179	0.138	0.179
F-statistic	78.57	42.73	41.27	41.27	39.82	43.10	26.77	27.86	22.55	26.89

ii. Robustness Check: Alternative estimation models

The cluster standard error can help address the issues of heteroskedasticity and autocorrelation. Additionally, it can provide more reliable and efficient standard errors when these problems are present (Stock & Watson, 2003). However, it does not deal with endogeneity, which leads to biased estimates. Endogeneity occurs from measurement error, omitted variables, or reverse causality (Stock & Watson, 2003). To address endogeneity, we employ a model with additional explanatory variables, a fixed/random effect model, a Generalized Method of Moments (GMM), and Two-Stage Least Squares (2SLS) (Trinh et al., 2020; Trinh et al., 2023; Ullah et al., 2018; Mollah & Zaman, 2015; Kashefi-Pour et al., 2020). Various techniques can be used to deal with endogeneity and improve the reliability and validity of estimates.

Table 5 presents the results for models with the additional variables (Panel A), the fixed/random effect model (Panel B), the GMM (Panel C), and the 2SLS (Panel D). As shown in Table 5 (Panel A), we control for a number of control variables, including firms' characteristics: Intangibility, liquidity measured by the quick ratio, and the bankruptcy risk measured by the Z-score; and macroeconomic factors: stock market volatility, the local stock market's capitalisation to GDP, national private credit, and investor protection index. The definitions, measurements, and data source of these variables can be found in Table 1 following previous studies such as Chen et al. (2021) and Kashefi-Pour et al. (2020); including additional variables can address the endogeneity issue of variable omission. Further dealing with the variable omission problem, the fixed effect model is also employed, which has been chosen over the random effect model based on statistically significant Hausman tests. The results of this model are revealed in Panel B.

Additionally, we implement the GMM and 2SLS to handle all sources of endogeneity (Trinh et al., 2020; Ullah et al., 2018; Mollah & Zaman, 2015; Kashefi-Pour et al., 2020). Regarding the two-step system GMM, as reported in Table 5 (panel C), there is a statistical significance in the first autocorrelation test (p-value(AR1) < 0.1). However, it has been shown that the second-order autocorrelation test (AR2) recorded statistically insignificant values. With the robust standard error option, the autocorrelation is not a concern. In addition, the models recorded insignificant Hansen tests for overidentification, indicating the appropriateness of our employed instrumental variables.

Lastly, regarding the 2SLS approach, as shown in Panel D, we employ two instrumental variables: the median of CEO power (CPS) at both country and industry levels and CEO retirements (as in studies of (Fan et al., 2021; Chintrakarn et al., 2015). An instrumental variable (IV) needs to meet two crucial criteria. First, it should be exogenous. Second, it should have a significant relationship with the explanatory variable of interest, such as CEO power (CPS). The reason for employing *the median CPS* of CEOs from previous studies is that it is likely to be positively associated with the CPS of the firm. This is because, within the same industry of the same country, similar criteria for appointing CEOs and comparable relative compensation for CEOs are applied. At the same time, the median CPS is not directly influenced by firm-specific characteristics, which makes it exogenous. Additionally, we use *CEO retirements* as another instrumental variable. This variable indicates whether the CEO is within two years of retirement or beyond retirement age. It is considered exogenous because the country's retirement laws and the CEO's biological age primarily determine it. We predict that this variable is positively related to CEO power due to CEOs' experience and knowledge. Thus, CEOs are likely to have more power as retirement approaches.

In the first stage of the 2SLS, we regress CEO power on the two instrumental variables (*retirement* and *CPS_med*). As expected, the coefficients for CPS_med and CEO retirements were positive (Table 5, Panel D). Furthermore, the result of the Hansen overidentification test was statistically insignificant. This validated and showed the appropriateness of the instrumental variables. Hence, it reinforces the integrity and effectiveness of the variables we employ in addressing endogeneity concerns (Albarrak et al., 2019).

Given the validity of these robustness checks confirmed by several tests, the findings are generally consistent with the main results. Particularly, supported by all models, increasing CEO power is likely to lower firm crash risk (DUVOL and NSKEW). The finding ensures the reliability of the main findings and supports the H1, which aligns with the agency theory perspective, emphasising the risk-averse tendencies of CEOs. In situations where CEOs hold substantial power, there is an inclination to protect the status quo by avoiding withholding negative news, leading to lower crash risk. Furthermore, the negative CEO power–crash risk relationship becomes more negative if firms support SDG-13 climate change actions, whilst the firm's GHG emission level does not influence such a relationship. In other words, firms that actively support SDG-13 are likely to signify ethical solid leadership, which is evident in their decision-making and their links to climate action and sustainability. This ethical commitment diminishes the CEO's tendency to misuse their power for personal gain, lowering the risk of crashes. Overall, the H2 is supported by all presented endogeneity treatments except for the GMM approach.

Table 5: Alternative estimation models - Endogeneity

Table 5 provides the alternative estimation models tackling the issues of endogeneity. Panel A represents the results of OLS regression with additional explanatory variables. Panel B presents the results of the fixed effect model. Panel C presents the results of the GMM model. Panel D presents the results of the 2SLS model. Definitions and measurements for variables are provided in Table 1. Standard errors are presented in parentheses. ***, **, and * indicate significance levels at 1%, 5%, and 10% critical levels, respectively.

	Panel A: Additional Variables		**Panel B: Fixed Effect**		**Panel C: GMM**		**Panel D: 2SLS**	
Variable	DUVOL (1)	NSKEW (2)	DUVOL (3)	NSKEW (4)	DUVOL (5)	NSKEW (6)	DUVOL (7)	NSKEW (8)
L.DUVOL	-	-	-	-	-0.262***	-	-	-
	-	-	-	-	(0.061)	-	-	-
L.NSKEW	-	-	-	-	-	-0.238***	-	-
	-	-	-	-	-	(0.067)	-	-
CPS	***-0.081*****	***-0.341****	**-0.141*** **	**-0.560*** **	**-0.224**	**-0.698** **	**-0.141* **	**-0.555* **
	(0.036)	***(0.192)***	**(0.042)**	**(0.179)**	**(0.177)**	**(0.338)**	**(0.072)**	**(0.290)**
CPS_GHG	***-0.040***	***-0.256***	**-0.012**	**-0.162**	**-0.263* **	**-0.776**	**-0.003**	**-0.165**
	(0.103)	***(0.477)***	**(0.100)**	**(0.430)**	**(0.139)**	**(0.760)**	**(0.099)**	**(0.415)**
CPS_ SDG	***-0.203*****	***-1.210******	**-0.184* **	**-0.870* **	**0.106**	**-0.677**	**-0.167* **	**-0.715** **
	(0.096)	***(0.456)***	**(0.105)**	**(0.449)**	**(0.366)**	**(1.738)**	**(0.098)**	**(0.360)**
GHG	0.029	0.108	0.017	0.063	0.705	0.433	0.018	0.078
	(0.030)	(0.142)	(0.028)	(0.120)	(0.478)	(2.678)	(0.028)	(0.122)
SDG	0.053	0.313	0.028	0.207	-0.118	0.192	0.028	0.160
	(0.042)	(0.215)	(0.041)	(0.177)	(0.184)	(0.972)	(0.038)	(0.155)
Intangibility	0.040*	0.387***	-	-	-	-	-	-
	(0.024)	(0.125)	-	-	-	-	-	-
Quickratio	-0.005	-0.032	-	-	-	-	-	-
	(0.004)	(0.022)	-	-	-	-	-	-
Z_score	0.014**	0.091***	-	-	-	-	-	-
	(0.007)	(0.035)	-	-	-	-	-	-
Mrk_stk_volatility	-0.003	-0.023*	-	-	-	-	-	-
	(0.003)	(0.014)	-	-	-	-	-	-
Stk_mrkmap_gdp	-0.000	-0.003	-	-	-	-	-	-
	(0.001)	(0.003)	-	-	-	-	-	-
Private_credit	0.000	0.001	-	-	-	-	-	-
	(0.000)	(0.002)	-	-	-	-	-	-
Investor_protection	-0.020*	-0.038	-	-	-	-	-	-
	(0.010)	(0.049)	-	-	-	-	-	-
Constant	0.131	0.975	-0.565***	-1.792**	0.008	0.985	0.125**	0.561**
	(0.153)	(0.769)	(0.165)	(0.705)	(0.249)	(1.065)	(0.058)	(0.234)
Controls	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*

Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,507	6,507	6,708	6,708	6,670	6,670	6,707	6,707
R-squared	0.252	0.187	0.249	0.198	-	-	0.209	0.159
F-statistic	35.58	24.17	49.14	36.57	-	-	-	-
2SLS first-stage								
Retirements	-	-	-	-	-	-	0.006	0.006
	-	-	-	-	-	-	(0.005)	(0.005)
CPS_med	-	-	-	-	-	-	0.074***	0.074***
	-	-	-	-	-	-	(0.022)	(0.022)
Hausman test (Chi-square)	-	-	77.30***	74.33***	-	-	-	-
AR (1) p_value	-	-	-	-	0.000	0.000	-	-
AR (2) p_value	-	-	-	-	0.11	0.12	-	-
Hansen-test (p_value)	-	-	-	-	0.667	0.964	0.189	0.150
Chi_sq (p-value)	-	-	-	-	-	-	0.0000	0.0000
F-test (p-value)	-	-	-	-	-	-	0.0000	0.0000

iii. Alternative approaches: The lagged dependent and weighted least square (WLS)

Table 6 presents the results of models with a lagged dependent variable (Panel A) and the weighted least square (Panel B). As stated by Kashefi-Pour et al. (2020) and Pindado, Requejo and De La Torre (2011), the former model captures the accelerator effect of this financial risk outcome. As can be seen, the coefficient of the **L.DV** is approximately 0.04 for both DUVOL and NSCKEW measures. This indicates that an increase in this year's crash risk can further drag another increase of 4% crash risk in the following year. Second, the WLS is employed to deal with unequal sample sizes across countries by providing equal weight for each sample in the estimation. Once again, the baseline findings are qualitatively confirmed, indicating that stronger CEO power is associated with lower crash risk, and the marginal reduction of crash risk with CEO power is stronger if firms support SDG-13.

Table 6: Alternative models – Lagged dependent variable &Weighted Least Square (WLS)

Table 6 provides the alternative estimation models with lagged dependent variables (Panel A) and WLS (Panel B). Definitions and measurements for variables in the Table are provided in Table 1. Standard errors are presented in parentheses. ***, **, and * indicate significance levels at 1%, 5%, and 10% critical levels, respectively.

	Panel A: Lagged dependent variable		Panel B: WLS	
Variable	DUVOL	NSKEW	DUVOL	NSKEW
L.DV	0.046***	0.040**	-	-
	(0.014)	(0.016)	-	-
CPS	***-0.075***	***-0.314****	**-0.075****	**-0.342****
	(0.035)	***(0.185)***	**(0.035)**	**(0.146)**
CPS_ GHG	***-0.038***	***-0.253***	**-0.019**	**-0.081**
	(0.104)	***(0.485)***	**(0.118)**	**(0.493)**
CPS_ SDG	***-0.200*****	***-1.080*****	**-0.212***	**-1.044****
	(0.089)	***(0.425)***	**(0.124)**	**(0.513)**
GHG	0.027	0.104	0.018	0.049
	(0.030)	(0.144)	(0.034)	(0.144)
SDG	0.043	0.331	0.053	0.356*
	(0.040)	(0.207)	(0.050)	(0.210)
Controls	Yes	Yes	Yes	Yes
Constant	-0.013	0.444	-0.045	0.230
	(0.080)	(0.437)	(0.083)	(0.351)
Year fixed effect	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes
country fixed effect	Yes	Yes	Yes	Yes
Observations	6,708	6,708	6,708	6,708
R-squared	0.246	0.181	-	-
F-statistic	39.53	26.69	-	-
Prob > chi2	-	-	0.000	0.000

iv. Robustness Check: Alternative independent variable & alternative GHG emission variables

An alternative proxy of CEO power is employed to further ensure our main findings, i.e., board independence. Board independence (Board_INDEP%) assesses the portion of independent and outside directors on the board, measured as the ratio of independent or external board members to the board size (Lewellyn & Muller-Kahle, 2012; Daily & Johnson, 1997). This measure aims to proxy the extent to which the board can independently control and supervise the CEO's power. A higher percentage of independent directors on a board typically indicates a lower level of CEO power or influence. This is because independent directors are less likely to have personal or financial ties to the CEO, making them more independent and objective in their decision-making. Consequently, a greater presence of independent directors suggests that the CEO has less control over the board decisions and may face more scrutiny and oversight. The result is presented in Table 7, panel A, indicating consistent qualitative findings such that firms led by more powerful CEOs are exposed to lower stock price crash risk. Furthermore, such a lower crash risk is lower if the firms exhibit stronger environmental practices through support of SDG-13.

Table 7 (panel B) reveals the regression results with alternative measures of GHG emission level. We consider the indirect GHG level (scope 2 and scope 3) into the GHG measures. These categories include, for example, according to Refinitiv, indirect emissions from consumption of purchased electricity, heat or steam, which occur at the facility where electricity, steam or heat is generated (scope 2) and emissions from contractor-owned vehicles, employee business travel (by rail or air), waste disposal, outsourced activities (scope 3). The indirect GHG level is not mandatory for firms to disclose and is often overlooked by market participants. Therefore, given the non-mandatory nature of the indirect GHG, if firms still aim to reduce this GHG category, it may strongly indicate the ethicality of CEOs as claimed by the signalling theory. The measures of alternative GHG are (1) the total indirect emission level containing both scope 2 and scope 3 (GHG2_3, as shown in columns 3-4) and (2) the total GHG emission level, containing all three scopes (TOTAL_GHG, as shown in columns 5-6). Once again, the qualitative findings remain the same and further ensure our main findings' creditability.

Table 7: Alternative measurements of CEO power and GHG emissions

Table 7 provides the alternative measurements of CEO power (Panel A) and GHG emission levels (Panel B). Definitions and measurements for variables in the Table are provided in Table 1. Standard errors are presented in parentheses. ***, **, and * indicate significance levels at 1%, 5%, and 10% critical levels, respectively.

	Panel A: An alternative measure of CPS		Panel B: An alternative measure of GHG			
	(1)	(2)	(3)	(4)	(7)	(8)
VARIABLES	DUVOL	NSKEW	DUVOL	NSKEW	DUVOL	NSKEW
Brd_indepen	**0.076*** **	**0.389*** **	-	-	-	-
	(0.016)	**(0.079)**	-	-	-	-
Brd_indepen _GHG	**0.011**	**0.117**	-	-	-	-
	(0.048)	**(0.224)**	-	-	-	-
GHG	-0.004	-0.067	-	-	-	-
	(0.027)	(0.122)	-	-	-	-
Brd_indepen_SDG	**-0.097***	**-0.397***	-	-	-	-
	(0.054)	**(0.237)**	-	-	-	-
CPS	**-**	**-**	***-0.074****	***-0.253****	***-0.071****	***-0.219****
	-	**-**	***(0.038)***	***(0.142)***	***(0.038)***	***(0.190)***
CPS_ SDG13			***-0.238*****	***-1.006*****	***-0.241*****	***-0.914*****
			(0.086)	***(0.318)***	***(0.086)***	***(0.303)***
SDG13	0.051*	0.253*	0.077*	0.360**	0.081**	0.334**
	(0.031)	(0.139)	(0.039)	(0.153)	(0.039)	(0.143)
CPS_GHG2_3	**-**	**-**	***-0.013***	***-0.050***	**-**	**-**
	-	**-**	***(0.025)***	***(0.100)***	**-**	**-**
GHG2_3	-	-	0.008	0.021	-	-
	-	-	(0.008)	(0.031)	-	-
CPS_TOTAL GHG			**-**	**-**	***(0.038)***	***(0.130)***
			-	**-**	***-0.041***	***-0.197***
TOTAL_GHG	-	-	-	-	(0.042)	(0.163)
	-	-	-	-	0.019	0.067
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.205***	-0.543**	-0.024	0.163	0.018	0.207
	(0.055)	(0.274)	(0.094)	(0.348)	(0.091)	(0.337)
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes

Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,863	12,863	5,418	5,418	5,394	5,394
R-squared	0.198	0.144	0.254	0.201	0.250	0.191
F-statistic	36.92	22.07	33.73	24.91	32.99	18.67

v. Additional analyses

Table 8 shows the results of additional analyses to better understand the effect of CEO power on crash risk and the moderating effect of environmental practices on such an effect across crisis and non-crisis periods (Panel A), financial and non-financial firms (Panel B), firms with high ES performance, and firms with low ES performance (Panel C).

During crises, CEOs may face increased incentives to conceal negative information due to various contextual factors, e.g., market volatility, reputation protection, short-term pressures, market perception, and personal gain, among the key drivers motivating CEOs to withhold adverse news. For instance, market volatility during crises can lead to significant stock price declines in response to negative disclosures, prompting CEOs to prioritise short-term stock performance over transparency. Additionally, CEOs may be more concerned about reputational damage during crises, as negative news disclosures could undermine stakeholders' trust and confidence in their leadership abilities. Moreover, the intense pressure to reassure investors and maintain stability may encourage CEOs to withhold unfavourable information to avoid further market disruptions. Accordingly, it is essential to understand whether the findings are driven and modified by the crisis periods.

The results presented in Panel A suggest that the negative impact of CEO power on crash risk and the mitigating effect of SDG-13 on this relationship are primarily driven by non-crisis periods (columns 3-4). In other words, CEO power does not appear to decrease crash risk significantly during crisis periods (columns 1-2, non-significant coefficients of CPS). This finding aligns with the above discussion that CEOs are exposed to increased pressures and incentives to conceal unfavourable information in times of crisis. However, when firms commit to SDG-13, CEOs can leverage their authority to promote transparency and reduce crash risk. This underscores the significance of market conditions in shaping the influence of CEO power on crash risk, as well as the critical role of SDG-13 environmental practices as a crucial ethical signal. By embracing such practices, firms can empower CEOs to foster greater transparency and accountability, enhancing overall corporate resilience and sustainability.

Furthermore, Panel B reveals that the main findings supporting H1 and H2 are only observed in non-financial firms. One potential explanation can lie in the distinctive operational characteristics of financial institutions. Unlike non-financial firms, financial institutions operate in a highly regulated and scrutinised environment with stringent transparency and disclosure requirements. Consequently, the inherent transparency standards in the financial sector lower any effect of CEO power on the concealment of negative information.

Lastly, the results presented in Panel C show that a negative relation between CEO power and crash risk is obtained only for firms with strong CSR (measured by the high environmental and social (ES) performance). Similar to SDG-13 as a conditional factor, firms with robust CSR practices prioritise transparency, accountability, and ethical conduct. Consequently, CEO power may be leveraged in such firms to reinforce these principles, leading to enhanced disclosure practices and reduced concealment of negative information. CEOs in CSR-focused firms are more inclined to align their decision-making with the broader interests of stakeholders, including shareholders, employees, and the community, rather than solely prioritising self-interest or short-term financial gains. As a result, the negative influence of CEO power on crash risk is mitigated in environments where CSR principles are deeply rooted.

Table 8: CEO power and firm crash risk across crises, financial and non-f f , d f ' f

Table 8 presents the results of the relationships between CEO power and crash risk and moderation during the global financial crisis and COVID-19 crisis (Panel A) across financial and non-financial firms (Panel B) and different ES performances (Panel C). Definitions and measurements for variables in the Table are provided in Table 1. Standard errors are presented in parentheses. ***, **, and * indicate significance levels at 1%, 5%, and 10% critical levels, respectively.

	Panel A: Crisis Vs Non-Crisis				Panel B: Financial Vs Non-financial				Panel C: High ES Vs Low ES			
	Crisis		Non-crisis		Non-Financial firms		Financial firms		High ES performance		Low ES performance	
Variable	DUVOL (1)	NSCKEW (2)	DUVOL (3)	NSCKEW (4)	DUVOL (5)	NSCKEW (6)	DUVOL (7)	NSCKEW (8)	DUVOL (9)	NCSKEW (10)	NSKEW (11)	NSKEW (12)
CPS	***-0.046***	***-0.242***	***-0.076*****	***-0.315****	***-0.088*****	***-0.380****	***0.130***	***0.818***	***-0.082*****	***-0.346****	***-0.044***	***-0.151***
	(0.065)	***(0.380)***	***(0.033)***	***(0.172)***	***(0.037)***	***(0.194)***	***(0.141)***	***(0.890)***	***(-2.117)***	***(-1.728)***	***(-0.520)***	***(-0.344)***
CPS_GHG	***0.018***	***-0.265***	***-0.042***	***-0.265***	***-0.016***	***-0.200***	***-0.803****	***-3.450***	***-0.057***	***-0.323***	***-0.093***	***-0.543***
	(0.166)	***(0.737)***	***(0.094)***	***(0.433)***	***(0.105)***	***(0.484)***	***(0.432)***	***(2.374)***	***(-0.510)***	***(-0.595)***	***(-0.251)***	***(-0.302)***
CPS_ SDG	***-0.231****	***-1.007****	***-0.196*****	***-1.026*****	***-0.166****	***-0.919*****	***-0.450***	***-2.863***	***-0.201*****	***-1.046*****	***-1.766******	***-11.471******
	(0.118)	***(0.549)***	***(0.090)***	***(0.423)***	***(0.094)***	***(0.438)***	***(0.322)***	***(1.864)***	***(-2.213)***	***(-2.426)***	***(-3.605)***	***(-4.292)***
GHG	0.038	0.181	0.026	0.103	0.016	0.066	0.309***	1.320**	0.032	0.121	0.008	0.042
	(0.047)	(0.214)	(0.028)	(0.134)	(0.031)	(0.147)	(0.106)	(0.567)	(0.963)	(0.732)	(0.081)	(0.082)
SDG	0.028	0.235	0.043	0.320	0.038	0.279	0.117	1.322	0.057	0.394*	0.321***	2.282***
	(0.046)	(0.235)	(0.041)	(0.208)	(0.042)	(0.212)	(0.170)	(0.930)	(1.350)	(1.838)	(4.310)	(6.223)
Constant	0.229*	0.751	-0.013	0.320	0.006	0.637	-0.569*	-3.003*	-0.024	0.353	-0.149	-0.002
	(0.131)	(0.729)	(0.074)	(0.393)	(0.084)	(0.460)	(0.305)	(1.649)	(-0.265)	(0.705)	(-0.731)	(-0.002)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
country fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,804	1,804	7,913	7,913	6,179	6,179	529	529	5,531	5,531	1,177	1,177
R-squared	0.223	0.144	0.244	0.180	0.233	0.169	0.430	0.354	0.242	0.187	0.279	0.190
F-statistic	12.07	7.07	44.45	30.28	35.19	23.53	8.10	5.87	32.41	23.29	8.36	5.08

6. CONCLUSION

This study examines the relationship between CEO power and stock price crash risk in the international setting and whether the relationship is moderated by firm environmental practices, i.e., GHG emission and SDG-13. The study makes its first contribution to the literature by employing a large global sample across the G7 countries. The analysis of the international dataset is significant in offering generalisable findings with broader applications on a global scale. Second, the analysis covers the period from 2006-2021, including major global events like the financial crisis and the COVID-19 pandemic. This allows for the evaluation of the CEO power-crash risk issue during stable and turbulent periods. Third, the study employs the most common measures of crash risk and validates results across multiple proxies. Fourth, it thoroughly examines the moderating effects of GHG emissions and SDG-13 on the relationship between CEO power and crash risk. The findings clarify how environmental responsibility efforts change the CEO power-crash risk relationship.

Under the baseline model, the results reveal a significant negative impact of CEO power and stock price crash risk. Specifically, the results indicate that for every one percent increase in CEO power, stock price crash risk measured by DUVOL is reduced by 8%, and by NSCKEW is reduced by 32%. This finding is consistent with the agency perspective. Regarding the second hypothesis (H2), the interaction term between CPS × GHG emission (CPS_GHG) was not statistically significant. This signifies that the level of GHG emissions does not influence the relationship between CEO power and crash risk. Nevertheless, firms' decisions on whether or not to support SDG13 regarding climate change action show a significant impact. Specifically, the coefficients of CPS_SDG13 are negative and statistically significant at the 5% level for both DUVOL and NCSKEW measures. Hence, the findings demonstrate that firms with better environmental responsibility exhibit a negative relationship between CEO power and crash risk. This shows that ethical cultures reflected in environmental performance can potentially limit the crash risk. Robustness tests ensured the main findings, including robustness across alternative model specifications, additional variables, measures, and subsamples.

There are several implications for stakeholders, including investors, directors, regulators, and public policymakers. First, investors can apply insights from this study to make informed decisions when allocating funds across companies with powerful versus less powerful CEOs and companies with different environmental practices. The evidence found in the current study indicates that investors can limit crash risk exposure when investing in firms with greater CEO power. Second, the board of directors can proactively establish governance mechanisms to constrain the CEO's absolute power. Compensation committees can also design incentive packages that reward transparency and stakeholder responsibility. Third, regulators can periodically evaluate governance and disclosure policies to ensure timely sharing of material information by firms and discourage the hoarding practices of influential executives. Finally, policymakers can pass disclosure rules, sustainability reporting requirements, and GHG emissions standards to promote transparency and ethical cultures within corporations. The findings provide vital evidence to advance practices, regulations, and policies for monitoring CEO power and mitigating crisis-related crash risks.

Chapter 5

1. CONCLUSION:

The thesis includes three empirical studies on CEO power and three risk aspects of firms. The first study explores the relationship between CEO power and firm risk at the onset of the global financial crisis 2007 and the COVID-19 pandemic in 2020. The second study analyses the impact of CEO power on firm tail risks globally and whether this effect varies during crises. The third study investigates the influence of CEO power on corporate stock price crash risk in an international context, along with the moderating effects of corporate environmental practices on this relationship.

a. First paper

i. Discussion of findings

The study provides empirical evidence of a significant positive relationship between CEO power and three types of firm risk: total risk, idiosyncratic risk, and systematic risk. The economic significance is more pronounced for total risk and idiosyncratic risk, indicating that CEO power's positive influence on firm risk is mainly driven by firm-specific risk. Lewellyn and Muller-Kahle (2012) recommended further research into the power of CEOs by developing a measure of possible sources of their compensation and power. Accordingly, this study follows that by using CEO compensation (CPS) and supports the findings of Lewellyn and Muller-Kahle (2012) and Sheikh (2019).

Our findings confirm these two studies conducted on firm samples, concluding that CEO power significantly correlates positively with firm risk. Extending their findings, this study also finds that the relationship between CEO power and risk is stronger in non-crisis periods. This suggests that power may allow and incline CEOs to take more risks in times of financial stability and discourage them (or at least encourage caution) from taking risks during crises. This argument complements the opinion of the behavioural agency model, together with inhibition/approach theory, that CEOs' risk-taking behaviour increases with power due to their propensity to be optimistic in their perceptions of risk (Anderson & Galinsky, 2006). A difference is made between the global financial crisis 2007 and the COVID crisis 2020. Particularly, the increased risk with CEO power remains relatively unchanged across financial and non-financial crises. However, such an effect only remains during non-COVID crises and disappears during COVID crises. This may be because the optimism and confidence of powerful CEOs are reduced during turbulence that they are unfamiliar with and have no reference to or experience of, which was the COVID case. CEOs with power are possibly more averse to increasing firm risk during new or 'strange' occurrences like a pandemic. It is possible that, if there is a similar public health crisis in the future, the relationship between CEO power and firm risk will be revealed since the health crisis will become a familiar phenomenon they have experienced.

Therefore, this study helps improve senior managers' selection processes and understand the risks linked to powerful CEOs during crises. As demonstrated in this study, power helps reduce overly cautious decision-making in CEOs' risk-taking. Such risk avoidance seems harmful to shareholder wealth. As the main findings of this study show, CEO power tends to increase firm risk, consistent with the findings of Finkelstein and Hambrick (1996) and Lewellyn and Kahle (2012). In this regard, the board of directors and top management are advised to grant more power to CEOs to achieve positive outcomes and meet firm objectives. Since CEO power is expected to work effectively and provide a good return on investment, they should curb the power of authoritarian CEOs and implement strict corporate governance to tap into firm potential and limit CEOs' risk-based compensation. Meanwhile, the confirmed positive relationship between CEO power and risk should serve as a signal to management, particularly the board, to monitor the risk-taking of powerful CEOs closely and ensure strategies that enhance value because higher risk can lead to excessive risk, which is harmful to firms if not carefully watched.

ii. Practical implications

This study has important implications for firms, investors, regulators, and policymakers. Policymakers can use the findings of this research as a practical tool to predict how crises might impact investors and the market by looking at how CEO power influences firm risk. Regulators could use this information to create better rules to lessen risk and prevent future problems. For example, the regulation, especially that oversees the whole market's risk, would go with a threshold of CEO pay slice. Based on the study's recommendations, firms and investors can gain deeper insights into how to handle the risks that come with powerful CEOs. This research is also helpful in improving the hiring processes for senior managers and understanding the risks that powerful CEOs pose during crises. Moreover, it encourages boards of directors and top management to give more authority to CEOs, which can help avoid the drawbacks of overly cautious CEOs and thus lead to positive results for the company. This is because CEO power is usually adequate and provides a good return on investment. At the same time, boards of directors need to closely watch the risk-taking actions of powerful CEOs to ensure that their strategies add value. This is important because taking on more risk can lead to greater rewards, but it can also result in too much risk, which is harmful to firms if not carefully controlled.

iii. Limitations and future research

While providing valuable insights into the relationship between CEO power and firm risk, this research has several limitations. First, it focuses primarily on large public firms in G7 economies, which may limit the generalizability of the findings to smaller firms, private companies, or emerging markets. The scope of the study is also somewhat constrained by its focus on G7 countries, which means it may not capture the full range of institutional or cultural factors that could affect the dynamics of CEO power and risk-taking in other regions. Additionally, the role of board dynamics in shaping CEO decision-making is not deeply explored, leaving a gap in understanding how board structure or independence might influence the risk associated with CEO power. Finally, there is limited analysis of how different governance mechanisms or policies could mitigate these risks, reducing the study's practical applicability.

Future research could address these limitations by expanding the scope and depth of analysis. Including smaller firms, private companies, and those from emerging markets would provide a more comprehensive picture of how different institutional contexts shape the CEO power-firm risk relationship. A broader cross-country analysis could also offer richer insights into how regional or cultural factors influence this dynamic, extending beyond the G7. Moreover, future studies could dive deeper into board dynamics, examining how factors such as board composition, independence, or the influence of key board members impact CEO decision-making. Finally, further research could investigate the effectiveness of various governance policies and solutions in curbing risks tied to CEO power, offering practical recommendations for mitigating these risks in different contexts.

b. Second paper

i. Discussion of findings

The results show that total tail risk for firms, including both firm-specific and market-based tail risks, rises with increasing CEO power. The link between CEO power, the expected shortfall, and its components is economically significant. Additionally, all coefficients are statistically significant at a 5% level or lower. This supports the behavioural agency model and inhibition/approach theory, which suggests that CEOs increased power supports their risk-taking tendencies due to an optimistic bias towards their risk perception (Anderson & Galinsky, 2006). Our findings also reveal a notable aspect: risk-related decisions by CEOs vary according to their power level. Specifically, more powerful CEOs tend to make more aggressive risk decisions, leading to higher total tail risk. This pattern is consistent for both firm-specific and market-based tail risks. Even during unstable periods like financial and health crises, the relationship between CEO power and firm tail risk remains largely unchanged. Additionally, these findings are primarily driven by non-financial firms and those with greater risk capacity, as indicated by their low R&D spending.

The study insights are valuable for improving senior managers' hiring processes and understanding the risks associated with powerful CEOs, especially during crises. It suggests that boards of directors should be more cautious about the decisions made by powerful CEOs because these decisions can lead to high levels of risk that could harm the firm growth. Effectively overseeing powerful CEOs might help manage these risks better. As disclosed by the key findings of this study, CEO power is more likely to cause firm tail risk to increase.

ii. Practical implications

This study has important implications for firms, investors, regulators, policymakers, and risk management. For example, policymakers can use the evidence of this study as a proactive tool to anticipate the impact of crises on investors and markets by analysing how CEO power affects corporate tail risk. Regulators may also establish improved rules and regulations to minimise risks and prevent future turbulences. Moreover, based on the recommendations, firms and investors can get deeper insights into managing tail risks associated with powerful CEOs. Hence. This study is useful for enhancing senior managers’ hiring criteria and understanding the tail risk associated with powerful CEOs during crises. Furthermore, the board of directors and top management are suggested to delegate more power to CEOs to avoid extremely conservative and value-damaging CEO strategies and stimulate positive firm outcomes. This is because the CEO power is expected to work effectively and achieve a reasonable return on investment. At the same time, the board of directors should pay more attention to the risks raised by powerful CEOs' decisions. This is because higher risks are expected to increase the excessive risk, which is detrimental to firms’ growth. In other words, overseeing powerful CEOs' decisions are more likely to help manage tail risk.

For risk managers, a key consideration is the balance of power and authority granted to the CEO and the CEO's employment terms, which can significantly impact the firm's risk posture. The appropriate power level given to the CEO often depends on the organisation's specific goals and risk appetite. When managing risk, aligning the CEO's influence with the firm's desired risk exposure is crucial. Suppose a firm takes on too little risk and wishes to increase it. In that case, one potential strategy is to enhance the CEO's decision-making power, enabling them to pursue more aggressive growth opportunities or strategic initiatives. This approach allows the firm better to align its risk-taking behaviour with its overall objectives, ensuring that risk management is about mitigation and optimising opportunities.

iii. Limitations and future research

While this research offers valuable insights, several limitations present opportunities for further investigation. First, the dataset focuses on large public corporations in the developed G7 economies, which may not fully capture the dynamics in smaller private firms or emerging markets. Future research could expand the dataset to include these companies, providing a broader perspective on how institutional contexts shape the relationship between CEO power and firm tail risk. Expanding the cross-country analysis to include more diverse nations beyond the G7 could offer richer insights into the global nuances of CEO power and firm risk. Another limitation is the lack of attention to industry-specific variations, which may be crucial in the CEO power-firm risk dynamic.

Future research could explore how different industries might influence or moderate this relationship. Moreover, the temporal scope of the current study is limited, potentially overlooking long-term trends or shifts in CEO behaviour and firm risk over time. Addressing this could enhance the understanding of evolving patterns in CEO decision-making. Finally, future studies should also assess the effectiveness of various governance mechanisms, policies, and solutions to mitigate risks related to concentrated CEO power, providing actionable insights for firms and regulators. Moreover, future research can examine how different leadership styles or cultural contexts might impact these relationships, which would add value.

c. Third paper

i. Discussion of findings

The findings indicate a significant negative relationship between CEO power and the stock price crash risk, suggesting that powerful CEOs are less likely to be associated with such risks.

This aligns with the agency theory, which posits that risk-averse CEOs are more inclined to maintain their current status, including their privileges, by not withholding negative information. This cautious approach to information disclosure helps reduce the potential for legal consequences and risks to their employment and reputation (Kasznik & Lev, 1995; Skinner, 1997). Moreover, the results show that firms with strong environmental responsibilities also exhibit a negative relationship between CEO power and crash risk. This supports the idea that SDG-13 reflects robust environmental practices within firms, often driven by CEO decisions, highlighting the ethicality of these leaders. Thus, ethical CEOs are less likely to hide negative news for personal gain, resulting in a more pronounced negative impact of CEO power on crash risk. Robustness tests were conducted to validate these results, including checks across different model specifications, additional variables, measures, and subsamples.

The findings are primarily influenced by non-financial firms and those with high Corporate Social Responsibility (CSR) performance, indicated by higher Environmental and Social (ES) scores. The data suggests that the negative impact of CEO power on crash risk and the mitigating influence of Sustainable Development Goal 13 (SDG-13) are mainly observed during non-crisis periods. Specifically, CEO power does not significantly reduce crash risk during crises, as shown by non-significant coefficients. However, in firms that prefer SDG-13, CEOs can use their authority to enhance transparency, thereby reducing crash risk. This highlights how market conditions can affect the role of CEO power in influencing crash risk and emphasises the importance of SDG-13 environmental practices as a key ethical indicator.

ii. Practical implications

There are several implications for stakeholders, including investors, directors, regulators, and public policymakers. First, investors can apply insights from this study to make informed decisions when allocating funds across companies with powerful versus less powerful CEOs and companies with different environmental practices. The evidence found in the current study indicates that investors can limit crash risk exposure when investing in firms with greater CEO power. Second, the board of directors can proactively establish governance mechanisms to constrain the CEO's absolute power. Compensation committees can also design incentive packages that reward transparency and stakeholder responsibility. Third, regulators can periodically evaluate governance and disclosure policies to ensure timely sharing of material information by firms and discourage the hoarding practices of influential executives. Finally, policymakers can pass disclosure rules, sustainability reporting requirements, and GHG emissions standards to promote transparency and ethical cultures within corporations. The findings provide vital evidence to advance practices, regulations, and policies for monitoring CEO power and mitigating crisis-related crash risks.

Additionally, several key points emerge when discussing how this study complements or challenges existing research on the financial implications of environmental practices. First, it could enhance current understanding by providing new insights into how focused environmental practices, such as reducing carbon emissions or meeting sustainability targets like SDG 13, directly influence a firm's financial performance. Additionally, it may challenge existing studies that view environmental practices as a cost burden by demonstrating their potential to create value through enhanced reputation, regulatory compliance, and long-term sustainability. This focus on the financial implications of environmental efforts could show that firms integrating strong environmental strategies mitigate risks and unlock opportunities for profitability and competitive advantage.

The study finds that strong environmental practices can reduce the risk of stock price crashes linked to powerful CEOs. This has important implications for corporate governance and sustainability:

For corporate governance, it suggests that sound environmental practices can check powerful CEOs who might hide bad news for their own benefit. By focusing on environmental responsibility, companies show they are committed to being transparent and ethical, which aligns with good governance principles of accountability and protecting shareholder interests.

For sustainability. Companies with strong environmental practices support sustainability goals like fighting climate change and protecting themselves from risks like stock price crashes. This creates a financial incentive for businesses to focus on sustainability.

iii. Operationalization of Environmental Practices

GHG emissions were quantified using standardised reporting frameworks, such as the Greenhouse Gas Protocol, which categorises emissions into Scope 1 (direct emissions), Scope 2 (indirect emissions from purchased energy), and Scope 3 (other indirect emissions along the value chain). Firms were required to report emissions data annually, normalised by revenue or output to compare across firms of different sizes. This data was integrated into the financial models to assess the relationship between GHG emissions and financial performance indicators, such as stock returns, profitability, and risk measures.

Support for SDG-13 was quantified by evaluating a firm's strategic alignment with climate action goals. This included metrics such as the percentage reduction in carbon emissions over time, investments in renewable energy, and participation in global climate initiatives. Firms that made significant progress in these areas received higher scores, which were integrated into the models as an indicator of proactive environmental strategies.

iv. Limitations and future research

While this research offers valuable insights, several limitations highlight opportunities for future exploration. First, the dataset is focused on large public firms in the developed G7 economies, which may not capture the full range of dynamics in smaller, private, or emerging market firms. Future studies could expand the dataset to include these firms, providing a broader understanding of how different institutional contexts influence the relationship between CEO power and crash risk. Additionally, the cross-country analysis is limited to G7 nations, leaving room for future research to explore a more diverse set of countries, which may reveal important regional or cultural variations in how CEO power affects firm risk.

Moreover, the study relies heavily on quantitative data, and future research could incorporate surveys or qualitative methods to gain deeper insights into how CEOs wield power and make decisions related to transparency and risk. Understanding these subtleties could offer a more nuanced view of the CEO's role in risk-taking. Lastly, further studies could assess the effectiveness of various governance mechanisms, policies, and solutions to curb CEO-driven crash risks, providing practical recommendations for firms and regulators to effectively manage and mitigate these risks.

v. Limitations of environmental practices measurement

Data Accuracy: Not all firms report emissions uniformly, and some rely on estimates rather than actual data, leading to potential inconsistencies.

In future studies, ISO 14000 standards can offer a structured and globally recognised framework for assessing a firm's environmental management practices. Since ISO 14000 provides a detailed and internationally accepted framework for environmental management, its use in studies enhances the validity of environmental performance metrics. By focusing on firms that adopt these standards, researchers can minimise variability in environmental data, ensuring that any observed effects on financial performance, risk management, or sustainability are more directly tied to robust environmental practices.

2. CONCLUDING REMARKS

Completing this research project has dramatically increased my comprehension of how CEOs' power influences firm risk dynamics. I sincerely hope that the findings and insights from my thesis will prove valuable in furthering knowledge within this field of study. However, the relationship between a CEO's power and a company's risk dynamics still has many unanswered questions. The implications of CEOs' decisions on greenhouse gas (GHG) emissions and their alignment with Sustainable Development Goal (SDG) 13 on climate action emerged as critical considerations during my research. Understanding how leadership influences a firm's environmental impact can provide valuable insights into risk management and sustainability strategies. My dataset covered periods of the financial crisis and the COVID-19 pandemic, allowing me to analyse how firm risk dynamics played out during economic turbulence and disruption. While I have made progress, there is still much more to uncover about the intricate dynamics between leadership power and corporate risk dynamics and how these dynamics evolve during crises versus more stable times. I am excited to build upon my thesis work by participating in future research projects that can further illuminate this compelling topic of firm risk dynamics.

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Appendix

Appendix 1

In this additional analysis, we explore how national cultural values, particularly Hofstede's uncertainty avoidance dimension, moderate CEO power's effects on firm risk, tail risk, and crash risk. Uncertainty avoidance refers to the extent to which societies tolerate ambiguity and uncertainty, with high uncertainty avoidance cultures favouring structured environments, clear rules, and predictability (Hofstede, 1980). In such cultures, powerful CEOs are likely to adopt conservative strategies focused on stability and risk mitigation, leading to lower overall firm risk. Conversely, powerful CEOs may feel empowered to take greater risks in cultures characterised by low uncertainty avoidance, pursuing innovative and potentially volatile strategies. This openness to uncertainty can increase tail risk and crash risk, as decision-making in these contexts may not sufficiently account for potential adverse outcomes.

According to the result table, the Cpower_D yields consistently positive coefficients for total risk, tail risk, and negative coffee coefficient for crash risk. This indicates that firms run by powerful CEOs are exposed to 9.2% greater risk than those run by non-powerful CEOs (for firm risk and tail risk) and exposed to -7.8 % lower than those run by non-powerful CEOs (for crash risk). This reinforces the study's findings regarding the influence of CEO power on firm risk, tail risk, and crash risk, as reported in the main analyses.

Furthermore, the interaction terms between uncertainty avoidance and CEO power (cpower_uai) are statistically insignificant across all the response variables. This implies that national culture does not exhibit statistically significant influences on the association between CEO power and firm risk, tail risk, and crash risk.

Appendix 1 Influences of CEO power on firm risk, tail risk and crash risk and moderation uncertainty avoidance (uai).			
Variable	**(1) Total risk**	**(2) Tail risk**	**(3) Crash risk**
Cpower D	0.0927**	0.0722*	-0.0766*
	(0.036)	(0.037)	(0.041)
cpower uai	-0.0011	-0.0009	0.0014
	(0.001)	(0.001)	(0.001)
uai	0.0046***	-0.0020*	-0.0015
	(0.001)	(0.001)	(0.001)
Controls	Yes	Yes	Yes
Constant	-1.5261***	0.3302	0.1263*
	(0.160)	(0.785)	(0.075)
Year fixed effect	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
country fixed effect	Yes	Yes	Yes
Observations	6,205	6,199	6,233
R-squared	0.220	0.205	0.234

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 2

Following the study by Uyar, Wasiuzzaman, Kuzey, and Karaman (2022), we controlled for the legal framework by utilising the Rule of Law index (ranging from -2.5 to 2.5) from the World Bank to enhance the robustness of our research. This analysis is constructive because the legal environment can significantly influence corporate governance and risk management practices. By accounting for the Rule of Law, we ensure that our findings regarding CEO power and its relationship with firm risk, tail risk, and crash risk are not confounded by variations in legal frameworks across different countries.

The consistent positive association between CEO power and both firm risk and tail risk and the negative association with crash risk indicates that our results are robust and consistent, regardless of the legal context.

Appendix 2 Influences of CEO power on firm, tail, and crash risks (additional variable legal framework).			
Variable	**(1) Total risk**	**(2) Tail risk**	**(3) Crash risk**
CPS	0.111***	0.095**	-0.073**
	(0.038)	(2.285)	(-2.040)
Controls	Yes	Yes	Yes
Constant	-1.459***	-1.325***	-0.311
	(0.221)	(-4.283)	(-1.517)
Year fixed effect	Yes	Yes	Yes
Firm fixed effect	Yes	Yes	Yes
Industry fixed effect	Yes	Yes	Yes
country fixed effect	Yes	Yes	Yes
Observations	11,150	11,143	6,631
R-squared	0.257	0.261	0.244

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1