UNIVERSITY OF CALIFORNIA,
MERCED

DISSERTATION

DOCTOR OF PHILOSOPHY
in Management of Complex Systems

By

Alireza Dastan

Dissertation Committee:
Associate Professor Russ McBride
Professor Anthony LeRoy Westerling
Professor Manuchehr Shahrokhi

2024

DISSERTATION SIGNATURE PAGE

UNIVERSITY OF CALIFORNIA, MERCED

The Undersigned Faculty Committee Approves the Dissertation of
Dr. Alireza Dastan

Beyond the Hype: Analyzing the Interplay of ESG Asset Performance, Market Sentiment, and Technological Drivers in the Maturation of Impact Investing

---

Russel McBride, Chair
Gallo School of Management, University of California, Merced

Anthony LeRoy Westerling
Gallo School of Management, University of California, Merced

Manuchehr Shahrokhi
Professor Emeritus of Finance and Global Business, California State University, Fresno

DEDICATION

To

My loving partner, supportive parents, and amazing sisters and friends

in recognition of their immense worth

"[as your everyday mantra] remember that there's a world out there trying to tell you who you are, and there's a world in here trying to tell you who you are. Now, where do you want to put your eggs? Because the world outside is very noisy and very tempting, and as all the razzamatazz, as all the tinsel, and all the glitter, they're just the toys. But that's because you don't think you're enough in the first place… *This* is the game!

Don't hate the player, don't hate the game. Love the game! Own the game! Play the game! Because you're in it already."

- *Guy Ritchie*

TABLE OF CONTENTS

ACKNOWLEDGMENTS

I would like to express my deepest gratitude to my esteemed committee chair, Assistant Professor Russ McBride, whose brilliance, both in thought and action, has been a constant source of inspiration. His unwavering enthusiasm for research, scholarship, and teaching has fueled my own passion for these pursuits. His guidance and dedication were essential to the completion of this dissertation, and without his support, this work would not have been possible.

I also wish to thank my committee members, Professor A. LeRoy Westerling and Professor Manuchehr Shahrokhi. Their work has shown me that a genuine concern for global issues, coupled with a commitment to comparative literature and modern technology, should always extend beyond the confines of academia and serve as a meaningful pursuit for our time.

Finally, I would like to extend my appreciation to Professor John Abatzoglou and Professor Paul Maglio, whose unwavering willingness to offer assistance at every step of the way was deeply appreciated.

The text of chapter 1 of this dissertation is a permitted adaption of the material as it appears in Shahrokhi, M., Parhizgari, A. M., Hashemijoo, M., Okafor, C. E., Nishikawa, Y., & Dastan, A. (2022). Corporate governance and stakeholder capitalism. *Managerial Finance*, *48*(8), 1123-1136

The text of chapter 3 of this dissertation is a permitted adaption of the material as it appears in McBride, R., Dastan, A., & Mehrabinia, P. (2022). How AI affects the future relationship between corporate governance and financial markets: A note on impact capitalism. *Managerial Finance*, *48*(8), 1240-1249.

The text of chapter 4 of this dissertation is a permitted adaption of the material as it appears in McBride, R., & Dastan, A. (2022). Ulcer index 2.6: A better risk measure? The Journal of Wealth Management Vol 25 Issue 3. Retrieved from DOI: 10.3905/jwm.2022.1.190

VITA

Alireza Dastan

2016 B.Sc. in Mechanical Engineering, Sharif university of Technology
2018 M.Sc. in Finance, University College Dublin, Smurfit Graduate Business School
2022 M.Sc. in Management of Complex Systems, University of California Merced
2024 Ph.D. in Management of Complex Systems, University of California, Merced

FIELD OF STUDY

Management of Complex Systems - *Sustainable Innovation, Entrepreneurship, and Finance*

PUBLICATIONS

McBride, R., Dastan, A., & Mehrabinia, P. (2022). How AI affects the future relationship between corporate governance and financial markets: A note on impact capitalism. *Managerial Finance*, *48*(8), 1240-1249.

McBride, R., & Dastan, A. (2022). Ulcer index 2.6: A better risk measure? The Journal of Wealth Management Vol 25 Issue 3. Retrieved from DOI: 10.3905/jwm.2022.1.190

Shahrokhi, M., Parhizgari, A. M., Hashemijoo, M., Okafor, C. E., Nishikawa, Y., & Dastan, A. Corporate governance and stakeholder capitalism.

ABSTRACT OF THE DISSERTATION

Beyond the Hype: Analyzing the Interplay of ESG Asset Performance, Market Sentiment, and Technological Drivers in the Maturation of Impact Investing

by

Alireza Dastan

Doctor of Philosophy in Management of Complex Systems

University of California, Merced, 2024

Assistant Professor Russ McBride, Chair

The underlying goal of all the research presented in this thesis is to increase the flow of investment toward sustainable technologies and social good. Our objective is to explore how to make sustainable investing mainstream and appealing to retail and institutional investors, regardless of whether their motivations are driven by altruism, financial returns, or somewhere along that spectrum.

This dissertation provides a comprehensive analysis of the impact of the investing landscape, exploring its influence on financial markets through empirical and theoretical lenses across four interrelated studies. The first study builds on these findings by examining B-corporations globally over 11 years, uncovering that market forces, rather than B certification, are the primary drivers of performance. The first study challenges common assumptions about the resilience of socially responsible investing (SRI) during economic instability. Analyzing a complex dataset from the largest economies in 2022 reveals that responsible investment generates no alpha compared to the market and can protect the portfolio. The third study focuses on the complex relationship between corporate governance and financial markets, proposing using artificial intelligence (AI) as a catalyst for sustainable reform. Finally, the fourth study addresses methodological limitations in investing research by refining risk assessment tools, specifically enhancing the Ulcer Index to UI 2.6, to capture investment drawdown severity accurately. This refinement aims to improve investment strategies and overall performance. In particular, more volatile and risky investments need to be managed with full knowledge of severe drawdowns in the short term. Collectively, these studies offer valuable insights into the evolving field of impact investing and its implications for both investors and broader financial markets.

INTRODUCTION

In recent years, there has been a lot of discussion on the relationship between corporate governance and social responsibility among academics and the business world. This shift indicates that the market is pushing the overall governance mentality towards a more responsible approach. They are also expected to be part of the solution to some of the world's biggest social and environmental problems as part of their core mission. This dissertation attempts to contribute to this ongoing discourse by exploring the various aspects of impact investing, corporate governance, and financial risk management in four separate but interconnected studies. Each study offers invaluable insight into the role of impact investing, responsible corporate governance, and elaborate risk management systems in the current global financial system and future prospects.

In the first chapter, we aim to comprehend whether market sentiment toward ESG compliance can boost or create an immediate momentum for reforming corporations to lower their cost of capital as an internal incentivization for investing in governance reform.

This study tests the effect of B-certification on firm performance and financial outcomes, with differences in observations made in the pre-certification and post-certification periods. According to the study, B Corporations are considered to be more sustainable than their conventional counterparts, but it is market forces, not B Certification, that seem to drive their performance.

The second study extends this discussion by analyzing the performance of the ESG asset class within public markets during periods of economic downturn, including the COVID-19 pandemic and the following wars in Ukraine and the Middle East. It is worth mentioning that the market sentiment for carrying the ESG asset class can go only so far. The financial return inspires asset allocation and financial market criteria in the long run. We want to discover whether socially responsible investors are sheltered more or less than the rest of the equity market. Nevertheless, the empirical support for this hypothesis was somewhat mixed; some research works have revealed that SRI provided some form of protection, while others have shown that SRI provided either minor or even inverse returns during bear markets. Again, the entire market is the sole driver, not particularly ESG asset class.

We attempted to bridge such a gap by assessing the performance of 5873 companies from the 25 biggest economies across the globe from January 2022 to November 2023, characterized by a good deal of financial instability and global exorbitant inflation. This study also shows that SRI had either a marginal or no significant positive effect on the portfolio returns during these chaotic months. These findings highlight that SRI is not all that it is cracked up to be as a financial strategy and, thus, dispels the notion that investing in SRI is safer during economic downturns. The study also emphasizes that SRI is less effective than a strategy in portfolio performance, as it may seem. It may be suitable for ethical reasons and future liability mitigation, but it does not produce better results than traditional investments in fluctuating markets.

The third study shifts the subject to corporate governance issues, emphasizing the relationship between CSR and financial markets. ESG factors have been rising in recent years, with corporations being pressured to deliver on social and environmental reporting. However, as the interest in CSR and ESG practices continues to grow, many firms struggle to integrate these concepts into their strategies. This study aims to determine how artificial intelligence (AI) can become the driving force for improving CSR and encouraging more effective business strategies.

Based on a qualitative analysis of one hundred scholarly articles, this study looks at the part played by AI in mediating and moderating the relationship between SRI and CSR. The study hypothesizes that AI can be used as a moderating variable to increase the effectiveness of SRI and a mediating variable that will encourage the practice of CSR among firms. For instance, AI can improve the ability of firms to track, measure, and report on ESG performance, thus enhancing transparency and accountability. Moreover, AI technologies can help firms adopt a sustainable business model since shareholder value converges with long-term sustainability objectives. This feedback loop system of SRI and CSR, with the help of AI, can finally result in the more responsible behavior of corporations and may contribute to the attainment of the UN SDGs and shift the paradigm across the different sectors. This study highlights how AI can change corporate governance and create a new sustainable and ethical financial system.

The last study addresses the shortcomings of conventional risk-reward metrics, particularly in the impact investing arena. If not the most, the Sharpe Ratio is one of the most commonly used measures of the risk-return profile of investment portfolios. Yet, it has been criticized for failing to capture the magnitude of potential losses or the non-normal distribution of returns. This study aims to highlight the limitations of the Sharpe Ratio and introduce a new approach using the Ulcer Index, a well-known measure of investment risk improved by adding the Ulcer Index-N and the Ulcer Performance Index-N.

These modified metrics help the investors gauge the actual risks of their portfolios, especially in volatile markets, because severe drawdowns can be detrimental to the portfolio's long-term returns. By introducing a more flexible way of measuring risk, the study advances more effective investment approaches that can better accommodate potential losses and assist investors in maneuvering through cloudy and volatile financial systems. This innovation benefits the impact investors who have to earn financial returns while creating positive social and environmental effects. By providing a more reliable tool for measuring risk, this study assists investors in making better decisions and improving their investment strategies to attain better risk-adjusted returns.

These studies show how impact investing, corporate governance, and financial risk management are changing the economic paradigm and the overall economy. They add to the current knowledge of firms' role in combating challenges such as climate change, social injustice, and increased corporate social responsibility. Thus, all the findings of this dissertation raise some questions about the assumptions that were previously considered in several aspects, such as the performance of the stakeholder-based business models, the effectiveness of SRI in mitigating financial risks during economic crises, and others. Also, the studies provide real-life examples of how artificial intelligence can be used to facilitate sustainable business strategies and improve this corporate dissertation governance, making valuable contributions to developing current debates and measures on how impact investing risk can be managed.

CHAPTER 1

Corporate governance and stakeholder capitalism

Alireza Dastan

Department of Management of Complex Systems, University of California Merced, Merced, California, USA

Abstract

Purpose – The authors revisit the inquiry into the primacy of shareholders *vis-`a-vis* stakeholders that has been debated since 19th Century. The authors consider B-business firms as the closest groups of firms that have considerable similarities to stakeholders' firms. The authors model the impact of being certified as stakeholders (B-business) firms in a worldwide environment.

Design/methodology/approach – Employing daily returns data of B-corporations in a global setting during 2010–2021, the authors quantify and compare the firms' performance in the pre- and post-certified periods, measure the effect of their environmental social governance (ESG) scores on their performance and gauge the entire results on a standardized approach that yields easy interpretation.

Findings – Subject to some caveats arising from limited coverage and the lack of data on proper control variables, the findings, based on the statistical significance of the estimated coefficients, do not indicate any changes in B-corporations' performance in their post-certification dates. Notwithstanding that, market factor appears to be the driving force consistently.

Originality/value – Prior studies on B-corporations are overwhelmingly qualitative. The current study is the first study that evaluate performance of B-corporations' returns at firm level with daily data.

Keywords B-corporations, Stakeholders, Shareholders, Impact measurement, Global firms

Paper type Research paper

1. Introduction

Firms operate and are managed differently worldwide and even within each country. While this statement seems obvious, a salient feature of management and operation of firms is often overlooked. This feature deals with differentiation between shareholders and stakeholders. In Japan, firms operate along the lines of "keiretsu." T. Boone Pickens, the famed American corporate raider, put a huge amount of his firm assets into Koito Manufacturing Co. shares and made himself the biggest shareholder in Koito [1]. This was a strategy to reach into Toyota Motor Corp for control. Yet, in a Koito board meeting he was shocked to find himself at the near bottom of the list to voice his position and preferences. He painfully realized that he could not change the structure of firms in Japan, not to mention that he had not established himself significantly among Toyota and Koito stakeholders though he held close to 20.2% of the Koito's shares.

In Russia, when the Government moved drastically to control the oil company Yukos, it was followed by a downward turmoil in the Russian stock market. But the influence of others, who were not necessarily shareholders in the market, revamped the market and gave birth to a substantial boom that the Russian stock market had not seen before.

In China, in the post-pandemic days, the stock market prices have been noticeably uneven. In the midst of all its stock market gyrations, the Chinese Government has tiptoed in and out to modify the wealth holders in some of the Chinese firms. This has led the chinses market to underperform, relative to the USA S&P 500, substantially in 2021. Yet, it remains to be seen if Russia's Yukos example may follow in the months ahead. A boom in the Chinese stock market due to structural revitalization in it by the Chinese Government, or a sustained downward movement in it due to continuing government interferences, remains to be seen. In a clear sense, the Chinese Government is a stakeholder in nearly all firms, and its recent interferences may be seen as controls that a huge stakeholder has chosen to mandate to protect or modify public interest.

In the USA, market forces seem to have dominated in this regard, though one may ask when or during what period? Historically, the transition between one forms of the firm to another has been gradual, though at times it has been relatively drastic due to government actions, which are not claimed to be a stakeholder position at all. Indirectly, the Government has acted as a stakeholder mandating certain actions that some, if not most, firms had to follow. Such actions have been substantial and some date back many decades. Some examples, among others, are as follows: Franklin D. Roosevelt (Social Security Act of 1935); Eisenhower (Department of Health, Education, and Welfare, 1953); Johnson (The Civil Rights Act of 1964, outlawing discrimination based on race or color, sex, religion or national origin; the Economic Opportunity Act, creating the Office of Economic Opportunity and beginning the war on poverty; legislation creating Medicare and Medicaid) and Reagan ("Reaganomics"– advocating tax rate reduction to spur economic growth, economic deregulation and reduction in government spending). And now, in the near-post-pandemic, the USA Government is posed with an overall US$ 3.9 trillion infrastructure bill that is expected to have substantial and enduring effects on firms and public positions. The bill, in additions to repairing roads and bridges, includes four weeks of family leave and three-year prepaid childcare expenses, among multitudes of other items. The Government is also coping with pandemic-related factors, experimenting with potentials to mandate vaccination and wearing mask.

The above instances indicate the forms that firms may take or be influenced or modified. Generally speaking, such changes could occur by direct actions within the firm or by indirect actions outside the firm in defense of public interest. In a sense, the latter could be interpreted as the influence of the general public stakeholder. Examples in the USA are many and diverse, from health related, to water supply, environment and even technology control.

What is interesting is that in the midst of all controls, interferences and firm evolutions, some firms are joining into different operational and managerial form, either by choice or by default. This group of firms has more resemblance to the Japanese "keiretsu" in the sense that internal stakeholders seem to gain dominance. We look at these firms more closely and

examine them to see if difference in some facets of their activities could be discerned. A common trend among this new group of firms is their inclination to be socially responsible and stay engaged in coping with global problems, including climate change. A measure of their actions in this regard is often cited as ESG score or index. But are these newer groups of firms different from the standard shareholder types of firms? We seek to provide some information and answer in this regard.

2. Literature review

At a time that global forces are focusing on finding remedies to cope with natural disarrays on planet earth, the actions, positions and views of the firms worldwide are increasingly more important. The G-20 summit and its subsequent COP-26 on climate change in October–November 2021 addressed a lot of items on their rich agenda, notably how to cope with extreme climate conditions. They made multi-billion-dollar commitments to mitigate future rise in temperature and help the nations affected. Yet, the individual positions of firms in this grand approach could not, admittedly, be considered. A united position was highly plausible and the only slight disarray, except for the timing of action by some member countries, was whether technological innovation could solve the problem. But this slight disarray was the position of a single country and was politely acknowledged [2].

In a recent study, Zhao and Parhizgari (2021) find that firms from countries with advanced technological innovation do not seem to be much concerned with climate change. Such firms seem confident that somehow technological innovations will solve the problem and they are not thus much concerned with climate crisis. This position ties well with Doerr (2021). Well, if this is the stand of some firms that happen to be the main players under this process, then one wonders how the world is actually going to win coping with climate crisis along the COP-26 agenda. This discussion obviously links with and points out to the significance of firms' positions and structures more so now than in the past, when public and private decisions are to be made and when the focus could be on the underlying players, i.e. the firms worldwide. Our focus in this study is thus on who is who in our current business environment.

The closest groups of firms worldwide that we can identify as stakeholder firms are B-business operations or entities or B-corporations. By default, such firms stand very noticeable in our analysis of stakeholders vs stockholders. They are, therefore, the focus of our attention. We identify their starting point or the date of their transition to B-business form. We seek to see the changes in them after their transitions.

Prior studies on stakeholders and shareholders are quite considerable. The studies on stakeholders are mostly qualitative. This is because data on stakeholder firms are not as commonly available as they are for shareholder firms. Pedrini and Ferri (2019) provide a systematic literature review of stakeholders. Miles (2017) discusses stakeholder definitions and theories. Some aspects of the negative aspects of stakeholders and their frictions are reviewed, respectively, by Harrison and Wicks (2021) and Jones *et al.* (2018).

The stakeholder topic is also covered in relation to other fields. For instance, Bridoux and Stoelhorst (2016) discuss the social welfare of stakeholders, Brulhart *et al.* (2019) look into the impact of stakeholders' orientation and environmental concerns on firm profitability and Fliaster and Kolloch (2017) focus on green innovations. Indirect or secondary actions of stakeholders and their reciprocity and responsibility are discussed, respectively, by Eesley and Lenox (2006) and Fassin (2012). In a fairly recent study Fama (2020) focuses on contract structures, i.e. the contracts negotiated among all participants who have interest in the firm. He also addresses ESG and argues that the governance part of ESG is still a part of the firm contracts, but the environmental and social (E&S) issues are more complicated. Fama's conclusion is that "market forces address the issues raised by the stakeholder capitalism and ESG movements." Fama's position is challenged by some who argue that the contents of the contracts are a continuation of the past firm practices and are short of directly creating badly new measures. A number of studies have focused on modeling one or more aspects of stakeholders (e.g. Hester, 2015; Elias, 2017; Jones *et al.*, 2018; Stretton, 2018; Gregory *et al.*, 2020). These studies,

however, are for the most part qualitative and do not provide empirical support. As such, they are in sharp contrast with contents and focus of our paper, which are to measure the relative performance of firms worldwide after they are officially certified as B-corporations, or as we call them stakeholder firms, and examine the impact of ESG scores on their performance. Prior literature has also undertaken specific coverages of stakeholders in relation to varied topics, for instance, employees as conduits for effective stakeholder engagements (Winkler *et al.*, 2019), consideration of corporate social responsibility (Yang and Basile, 2021), participation in water resources management (Sigalla *et al.*, 2021), management performance and new entry (Laplume *et al.*, 2020) and various impact analyses (Schneider and Sachs, 2017; Pirozzi, 2019; Hillenbrand *et al.*, 2013).

In what follows, we first look into firm governance, stakeholder capitalism and challenges that we are encountering. Then, we discuss the data and our methodology that is tailored to address the focus of this paper. This is followed by the presentation and discussion of our empirics. We conclude in the last section. Firm governance, stakeholder capitalism and challenges

Firm governance takes complex and detailed dimensions. A recent comprehensive World Economic Forum study provides a dynamic system that elaborates upon several firm governance dimensions and links them together dynamically. Exhibit 1 provides a graphical-*static* presentation of this system [3]. The *dynamic* aspect of the system is available in the main source of the study [4]. Starting with 7 main topics on corporate governance, the linkages to as many as 44 sub-topics are established. This comprehensive chart attests to the complexity that corporate governance is facing.

Within the above complex system, corporate governance and corporations are now under increasing pressure to seriously account for their impact on people and environment beyond just maximizing financial returns. Milton Friedman's blueprint is faded, and in some corporate entities, it is now fully discarded. Instead, an evolution to consider a different venue has already gained substantial momentum. For instance, in addition to attention to ESG, sustainability, global warming, extreme weather conditions, the new platform of social business and social media is promoting conscious capitalism, a movement that aims at "aligning and combining the power of capitalism with the global human consciousness" [5]. We note that the term "socialism" is intentionally avoided to repudiate the negative accusations that this term could create.

The above movements are in sharp contrast with the literature on firms' position in the 1970s. The primacy of shareholders took the center stage with Milton Friedman's article in *New York Times* in 1970, advocating that the "responsibility of business is to increase its profit" and that "the shareholders come first." Thereafter, this idea was embraced as the goal of the firm and established the responsibility of firms' CEOs.

The above, i.e. 7hareholderr primacy, was seriously challenged on August 19, 2019, when the Business Roundtable Corporations overturned its former policy statement and adopted a new statement on the "Purpose of a Corporation," declaring that companies should serve not only their shareholders, but also deliver value to their customers, invest in employees, deal fairly with suppliers and support the communities in which they operate [6].

In a recent article, Lasicki (2020) provides an interesting brief history of shareholders *vis-`a-vis* stakeholder. He points out a key ideological shift in the USA [7]. While in the early 1800s the focus was on stakeholders, in the late 1800s this focus shifted to shareholders and remained so until 2019. This is a U-turn in a key USA ideology after nearly 120– 130 years!

We would be remiss if we do not add a note of serious concerns. The pros and cons of shareholder firms are widely covered. Those of the stakeholders, though also plenty, are not yet fully analyzed. We distinguish between "real" and "nominal" stakeholder capitalism. The latter has often carried a sales pitch and has stayed under radar. For instance, a point of serious departure is Goodman's (2022) work. He argues that notwithstanding all the benefits that stakeholder capitalism could offer, some serious flaws still do persist. For example,

stakeholder capitalism "is all unilateral. There is no labor unions in stakeholder capitalism, government does not really exist in stakeholder capitalism. It is not the talking point. It is all about us depending upon the goodness of people, [...] [ ], who run the companies" [8]. Ina

related narrative, Schwab (2021) points out the challenges we face and advocates innovation, fair competition, responsible business and an "urgent reset of capitalism."

In support of the pros of stakeholder capitalism and notwithstanding the negative assertions against it, there is already overwhelming evidence, all emanating from stakeholder consideration, that attests to ample improvements in many facets of firms and society in general. There is now a widespread knowledge that firms need to pay attention to planet earth, to their employees, to their customers and to other facets of our intertwined social and economic complexities, including income inequality. The positive effects of these improvements that have mostly evolved during the past 20 plus years are often difficult to measure directly, but there are already a growing body of research in this direction and it is gaining momentum (see, for instance, Bofinger *et al.*, 2022; Ferres and Marcet, 2021; Pedersen *et al.*, 2021).

In this paper our focus is limited. As a link to or a limited substitute for the above discussions, we have chosen B-business firms that are the closest groups of firms that have considerable similarities to stakeholders' firms. The literature defines B-corporations as "*the category of socially responsible firms in which the fiduciary duty is defined by shifting focus to all stakeholders as opposed to the Delaware provision view on prioritizing shareholder value only*" [9]. Further, our focus is on certified B-business, or B-corporations, which are third-party certification administered by the non-profit B-Lab, based in part on the firms' verified performance [10].

3. Data

The data are daily and span 2010 to 2021. i.e., the earliest and the latest date for which we have B-corporations in the worldwide markets. Firm stock prices are obtained from Yahoo Finance and are then converted into returns. Global stock market returns are from Datastream. Information on B-Corporations and various measures of ESG are from "data.world." This database is annual and its aggregate frequency does not impose any constraint on our use of data at daily frequency. Our preference for daily data arises from the need to capture changes that could occur in the B-corporate firms from the start of their transition immediately in the post-certification dates. Such changes may be short term, though they may also extend into long term.

Though our data span over 12 years, not all daily observations are employed in the estimation process. This is due to the methodology that is employed. We will discuss limitation of data in section 5 on empirical applications.

4. Methodology

While we have the option of several measures to gauge the B-corporations, a measure that yields better to empirical accuracy for all firms worldwide and is also available in higher (5daily) frequency is the returns on their stock prices. Other measures such as market value, book value, Tobin's Q and combinations of them do not yield to high frequency data application, though they are important measures for firm valuation, particularly when the span of analysis is medium to long term. We, therefore, employ firms' daily returns, calculated from their daily stock prices.

We propose a panel data model based on an expanded market-type model as follows:

$$\mathrm{R_{i;k;t}} = \beta_0 + \beta_1 R_{i;\,k;t-1} + \beta_2(RM_{k;t-1} - RF_{k;t-1}) + \beta_3\ \mathrm{Controls_{k;t-1}} + \theta_{i;k;t} + \gamma_{k;t} + Industry_{jk} + \mathrm{Year} + \varepsilon \quad (1)$$

where $R_{i;k;t}$ is return on firm i in country k at time t. $RM_{k;t}$ and $RF_{k;t}$ are, respectively, the market return and risk free rate of return in country k at time t. The variables $\theta_{i;k;t}$ are other firm level controls, $\gamma_{k;t}$ are country level controls and $Industry_{jk}$ is j-industry level control in country k. The variables $R_{i;k;t}$ and its corresponding market excess return are lagged to account for omitted variables and, to some extent, the endogeneity problem, if any. Firm and market returns are all at daily frequency. The control variables are for the most part dummy indicators except when ESG measures are entered into the relation as additional components of the $\theta_{i;k;t}$ firm controls. This variable also includes a binary variable of zero (and one), identifying the firms before (and after) B-corporation certification. This binary variable is of special interest to us and we designate it as $DC_{i;k;t}$ in the presentation and discussion of our empirics in Section 5.

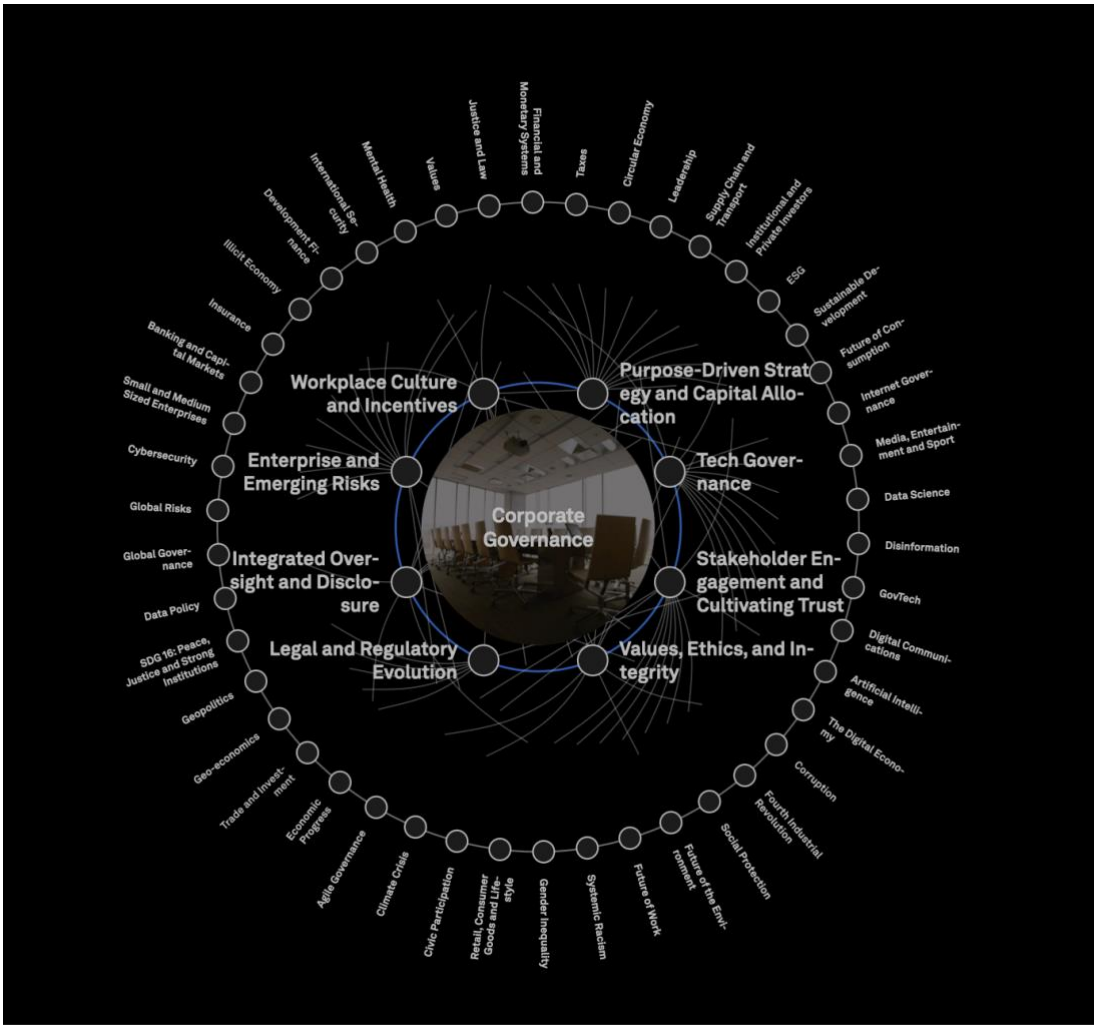

Exhibit 1. Corporate governance
Note(s): The authors express their thanks to © World Economic Forum, Strategic Intelligence, for permission to replicate the above char.
Source(s): © World Economic Forum, Strategic Intelligence, 2022. Corporate Governance https://intelligence.weforum.org/topics/a1G0X000005JLTqUAO

Relation (1) is to be estimated after all firm data are centered on the dates of firms' B-corporate certification dates. Designating the certification date for each firm as C_t, then (C_t —10) to (C_t —190) and (C_t +10) to (C_t + 190) days are selected for each firm estimation. As such, a short period of 20 days around the certification dates is excluded in case the news about

certification may have been released in advance or delayed. This short window is also separately considered to see if there is a sharp (spike) in the returns immediately after the announcements. The time duration of 6 months (180 days) as well as the window of 20 days could be changed in robustness checks. We acknowledge that these values are arbitrary choices, but we note that they are based on practical observations and experiences in financial markets. They also conform to most practices in prior research.

A variant of the above procedure could seek "*immediate market reaction*" to firms' change of status to B-corporation after the B-certification date C_t. Crucial in this type of analysis is when exactly the information about B-certification reached the market. It is often possible that such information may have reached the market days or even weeks in advance of C_t. Thus, C_t may not be the true or real date of B-certification *for the market*. Hardin *et al.* (2020) discuss how pinpointing the true (5 real) date, not the registered (5 official) date, of a status change could be elaborate and extensive. Assuming that C_t is the real date of the status change, a variant analysis over the period of (C_t —10) to (C_t +10) may be undertaken to show the immediate market reaction to obtaining B-corporation status. The before and after- number of days (510) may be changed in robustness checks.

We also conduct a few additional analyses. First, relation (1), in addition to being estimated over the entire data, is estimated over two distinct sub-samples. One sample for the periods before the certification dates, and the other sample for the periods in the post-certification dates. The resultant separate equation estimates are econometrically compared. Finally, the entire data are standardized using Huber M-estimator and relation (1) is estimated. This procedure clearly indicates the relative positions of the B-corporations before and after their certification dates. The estimated coefficients simply convey the magnitudes of differences. Further, Huber M-methodology accounts for robust outliers and to this extent the problem of outliers in data, if any, is addressed.

5. Empirical application

While data on firm returns (or firm stock prices) and their respective country return indices are standard and are fairly widespread in their availability [11], data on B-corporations impose serious constraints. "data.world" provides an extensive database that covers, based on their information, 4,152 firms in 153 industries across 77 countries. While this appears very promising for a detailed analysis of B-corporations, upon scrutiny this vast amount of information does not yield to easy empirical examination of the B-corporation firms.

Ideally, a researcher opts to include as many B-corporations in the analysis as possible. But the B-corporations are for the most part small businesses with not much public data at all. Further, a very high percentage of the larger B-corporations are not publicly traded and data on them are either non-existent or are proprietary information. More troubling is the special firm IDs that are assigned to the B-corporation firms. Though the assigned IDs are unique and advantageous in tracing the firms *within* the B-corporation database, they do not match any IDs in other databases. There is currently no data available to cross reference between the IDs. This simply may be because the B-corporation firms are rarely present in other databases.

In due time, "data.world" or other potential databases on B-corporations need to address, and probably resolve, some or all of the above constraints. Currently, faced with the above unresolved limitations, we have opted to focus our applications on those B-corporations that are publicly traded, assuming that we can compile relevant data on them. Our step-by-step process includes:

(1) Starting with 8,178 records of data from "data.world", we delete firms that show 0 (zero) for size (5number of employees). The reason should be obvious.

(2) We then delete firms with sizes 1–9 employees, assuming that such firms are too small to be publicly traded or have some data available.

(3) We delete firms that are decertified.

(4) After the above 3 steps, we are left with 3,300 records of data. This is about 60 percent

reduction in the original data.

(5) Some B-corporations are re-certified (usually every 3 years). We flag these firms. Different treatment was necessary

(6) We then manually search to identify the B-corporations that are publicly traded.

(7) In step 6 above we ensure that the selected firm is a B-corporation, and not its parent or affiliated company that may not be B-certified.

Table 1 lists the B-corporations that are publically traded. We acknowledge that our manual search is not comprehensive and may not include all the publicly traded B-corporations.

To illustrate the application of the methodology that we discussed in section 3, we estimate relation (2, see below) using only a subset of 11 firms listed in Table 1. We acknowledge that our coverage in this regard is illustrative or expository and not an effort to empirically test a hypothesis. This is mostly due to the small sample that is considered in this exposition and the constraints that are seriously present concerning data availability and firm identification. For instance, initially we considered 40 publically traded B- corporations and gathered data for them. About half of them did not match with any of the firms in "data.world" database, and seven of them did not have complete data around the certification dates.

We consider each firm individually and then all of them combined (panel analysis). We also make one modification in relation (1) by estimating the market variant of it as follows:

$$R_{i;k;t} = \beta_0 + \beta_1 R_{i;k;t-1} + \beta_2 (RM_{k;t-1}) + \beta_3 \text{ Controls}_{k;t-1} + \theta_{i;k;t} + \gamma_{k;t} + Industry_{jk} + \text{Year} + \varepsilon \quad (2)$$

Summary statistics on the returns of the illustrative sample of firms are in Table 2, and their certification dates and related B-corporation statistics (size, ESG score, country and industry) are in Table 3.

The estimated results of relation (2) for each of the B-corporate firms are included in Table 4. For brevity, only the coefficients of the main variables are included. The main variable of interest is $DC_{i;k;t}$, i.e. the binary variable of zero (and one) that identifies the firms before (and after) obtaining B-corporation certification. Based on the statistical significance of the estimated coefficients, and particularly for $DC_{i;k;t}$, we conclude that market is the driving force and the effect of being certified ($DC_{i;k;t}$) is not statistically significant.

The above conclusion runs against our *a priori* expectation and we attribute it to the caveats of our application that arise mainly from the lack of sufficient data and appropriate control variables. For instance, the size variable is based on the number of employees and its measurement is not accurate since a range of numbers are provided in the database. This may have been due to firms' reporting over a longer period of time, but we expect, at least, a more accurate measure on or around the certification date. Further, the number of employees may not be an appropriate measure. It is well known that a measure of firm's assets (that are not easily available for B-corporations) is a better measure.

Another major caveat may be attributed to when exactly the news about B-certification reached the market. We have relied on the dates provided by the B-lab database but the true or real effect of any change may have occurred days or months earlier if the news was released. Hardin *et al.* (2020) show how important and significant this consideration could be. Therefore, based on the limited statistical tests that are reported in Table 4 and the caveats we have cited, we cannot verify *statistically* any indications of changes in firms' performance in their post-certification date. The signs and the magnitudes of the coefficients of $DC_{i;k;t}$ indicate, respectively, the direction of the change (increase or decrease in valuation or performance) and the estimated size of the change.

Variant estimates of relation (2), as discussed above and in Section 3, are possible.

Noteworthy is panel estimation of all B-corporate firms. The results of such estimation are included in Table 5. Our conclusions on the resultant estimated coefficients in Table 5 stay the same as in Table 4. In Table 5, we are able to consider extra control variables such as country, industry, varied country return indices and firms' ESG as provided by the B-lab database. Again, as in Table 4, the market effect overwhelms all the other attributes. We note that inclusion of the lagged dependent variable on the right-hand-side of relation (1 or 2) could account for the omitted variables, if any, and the presence of endogeneity to some extent. Despite this consideration, we acknowledge that our empirical application may still have some caveats due to the lack of data and proper control variables.

Another variant of our empirics is to produce all the estimated results on the basis of standardized coefficients. This variant reflects the contribution of each variable to the B-corporate returns. For brevity, the results for the individual firms and panel analysis are not included. Our conclusions under these scenarios remain unchanged, though the interpretation of the results becomes easier.

6. Conclusions

We started this paper by citing Japanese "keiretsu' as a near perfect example of stakeholders firm. We like to end with another Japanese term Ikigai (生き甲斐, "a reason for being"), which encourages a person to ask why people wake up in the morning. To do what? Making a profit? Sharing with others? Keeping a safe and undamaged environment? And in brief, what is the world demanding from us? We seem to have neglected some of these "life-long" attributes and instead have narrowly rested on a few under the umbrella of capitalism.

The outcome is neither clear nor promising unless we agglomerate behind some initiatives that have gained some momentums in the last decade or so. One of them is ESG and its related firms' B-corporations or stakeholders.

In an effort to quantify a limited aspect of our progress under B-corporations, stakeholders firms and ESG measures, we considered daily returns of B-corporations and provided a feasible model to gauge the effect on them after firms achieve B-certification status. We provided a limited number of illustrative examples on the application of the model. To make the applications feasible, we limited them to publicly traded firms for which we could obtain the returns or stock prices.

Our results could not statistically confirm a major change for a firm due to becoming B-certified. This could be good or bad news. On the one hand, it is often argued that consideration of ESG requirements and adherence to them are costly and the firm may lose value. We did not see it in our limited illustrative examples. On the other hand, it could be argued that the future of compliance with ESG and its demands could lead to prosperous returns for the firms. We could not see this one either.

But what is clear is that adherence to ESG and other related factors are certainly positive for the well-being of all, if for nothing else, and, at least, in the spirit of "Ikigai."

Future research on this topic demands more data and a thorough investigation on when the news on B-certification reached the market.

Panel A: Public B-corps Firm names	Notes
Australian Ethical (SX: AEF)	Certified in 2014 as a public company
Laureate (NASDAQ: LAUR)	Certified prior to their IPO in 2017 – IPO'd as both a B-corp and benefit corp
SilverChef (Australia)	Certified as a public company in 2015
O-Bank (Taiwan)	Certified as a public company in 2017
Kathmandu (New Zealand)	Certified as a public company in 2019 - public since 2009
Benefit Systems (Poland)	First public company to certify in Europe in 2018
Amalgamated Bank (NASDAQ: AMAL)	Certified prior to their IPO in 2018
Movida Aluguel de Carros (B3: MOVI3) (Brazil)	Certified as a public company
Synlait Milk Limited (Australia-ASX: SM1; New Zealand-NZX: SML)	Certified as a public company
Arowana International (Australia-ASX: AWN)	Certified as a public company
Vivo Power (VVPR (NASDAQ))	Certified as a public company
Cafe Direct:	Certified as a "public" company but not listed on a well-known exchange (https://www.ethex.org.uk/Cafedirect)
Holaluz (Spain-BME: HLZ)	Certified Jan 2019 and went public in November 2019
Lemonade (NYSE: LMND)	IPO'd as both a B-corp and benefit corp
Vital farms (NASDAQ: VITL)	IPO'd as both a B-corp and benefit corp
Appharvest (NASDAQ: APPH)	
Panel B: Public companies with one or more B-certified subsidiaries	
Unilever (NYSE: UN): Pukka (UK), Mãe Terra (Brazil), Sir Kensington's (USA), Ben & Jerry's (USA), Olly Nutrition (USA), Seventh Generation (USA), Sundial (USA), T2 Tea (Australia)	
B2W (B3: BTOW3): Courrieros (Brazil)	
Procter & Gamble (NYSE: PG): New Chapter (USA)	
AB Inbev: (4 Pines Brewing Company)	
Azimut Group: (AZ Quest)	
Banco Estado: (Banco Estado Microempresas, Caja Vecina)	
Campbell Soup Company: (Plum Organics)	
Coca-Cola: (Innocent Drinks)	
Fairfax Financial: (The Redwoods Group)	
Gap: (Athleta, Hill City)	
Kikkoman: (Country Life)	
Lactalis: (Stonyfield farm)	
Land O' Lakes: (Vermonta Creamery)	
Nestle: (Essential Living Foods, Garden of Life, Lily's Kitchen)	
Oppenheimer Funds Inc.: (SNW Asset Management)	
Rakuten: (OverDrive)	
The Hain Celestial Group: (Ella's Kitchen, Better Bean)	
Vina Concha y Toro: (Fetzer Vineyards)	
Hortfruti S.A.: Hortifruti Chile	
Danone SA: Danone North America, Alpro, Danone Waters of America, Danone Canada, -Aguas Danone Argentina, Bledina, Danone Aqua Indonesia, Danone Egypt, Danone Iberia, Danone Manifesto Ventures, Danone UK, Grameen Danone Foods, Happy Family, Les 2 Vaches, Danone Waters Germany, Danone Dairy Ireland, Danone Waters Spain, Danone Netherlands, Danone Dairy Belgium, Nutricia Bago, Danone ELN Greater China, Danone Japan, Volvic	

Table 1. B-corporations *(Continued)*

Panel C: B-Corps acquired by public companies
Plum Organics by Campbell Soup Company (NYSE: CPB)
Happy Family by Groupe Danone (OTC: DANOY)
Five:am by PZ Cussons (LON: PZC)
Panel D: Other B-corps with market value as of January 31, 2020
Danone, EPA: BN, US$47.0 B
Natura & Co, NYSE: NTCO, US$9.5 B
Laureate Education, NASDAQ: LAUR, US$4.3 B
Australian Ethical, ASX: AEF, US$0.5 B
SilverChef Group, ASX: SIV, US$0.02 B

Note(s): This table includes public firms that are B-certified. The list is work-in-progress and may not be complete

Source(s): B-lab corps discussions sites and authors' search

Table 1. B-corporations

Company name	Country	Industry	Date of B-corp certification	Size	ESG score
Australian Ethical	Australia	Financial services	2/6/2014	10–49	130.6
Movida Aluguel de Carros	Brazil	Business products and services	1/10/2020	1,000+	83.4
Kathmandu	New Zealand	Consumer products and services	8/19/2019	1,000+	82.2
SilverChef	Australia	Financial services	6/23/2015	50–249	83.1
Benefit System	Poland	Business products and services	7/4/2018	250–999	80.1
O-Bank	Taiwan	Financial services	10/9/2017	250–999	88.1
Vivo Power International Pl	The United Kingdom	Energy and environmental services	4/10/2018	10–49	85.7
Synlait Milk Limited	Australia	Agriculture	6/18/2020	250–999	80.4
Vina Concha y Toro	Chile	Food and beverage	1/1/2021	1,000+	81.4
Danone	USA	Food and beverage	4/2/2018	1,000+	96.00
Natura & Co	Brazil	Home and personal care	11/19/2020	10,000+	110.4

Note(s): This table summarizes information about country, industry, date of being certified as B-corp, size and ESG score for the firms in the illustrative sample

Table 2. Company Description

Company name	Return before certification	Return after certification	Diff in returns	*t*-stat
Australian Ethical	0.24%	0.30%	0.06%	0.2293
Movida Aluguel de Carros	0.21%	0.54%	0.33%	0.2611
Kathmandu	0.08%	0.11%	0.03%	0.0748
SilverChef	0.34%	0.08%	−0.26%	−0.9633
Benefit System	−0.10%	−0.19%	−0.09%	−0.3396
O-Bank	−0.02%	−0.01%	0.01%	0.0584
Vivo Power International Pl	0.04%	0.68%	0.64%	0.3636
Synlait Milk Limited	−0.11%	−0.20%	−0.09%	−0.2244
Vina Concha y Toro	0.00%	0.07%	0.07%	0.2842
Danone	0.03%	0.00%	-0.03%	−0.2432
Natura & Co	0.44%	0.07%	−0.37	−0.8985

Note(s): This table presents results of univariate analysis comparing raw returns before and after being certified as B-Corp for the firms in the sample

Table 3. Univariate analysis of raw returns before and after certification

Table 4. Multivariate analysis of returns for individual firms

Company name	Coefficient ($DC_{i,k,t}$)	*t*-stat
Benefit System	−0.001387	−0.53
Movida Aluguel de Carros	−0.000759	−0.22
SilverChef	−0.014132	−0.67
Synlait Milk Limited	0.0243,336	0.79
Vivo Power International Pl	0.0007851	0.00
Australian ethical	0.0028566	0.18
Kathmandu	0.0003489	0.11
O-Bank	0.0013214	0.12
Vina Concha y Toro	0.0008022	−0.17
Danone	−0.0006101	−0.50
Natura & Co	−0.0043587	−1.07

Note(s): This table presents results from regression of return on market return, lagged return, size and $DC_{i,k,t}$ for each firm in our sample. $DC_{i,k,t}$ is the binary variables of zeros (and ones) that identifies the firms before (and after) obtaining B-corporation certification. For brevity, only the coefficients of $DC_{i,k,t}$ for each firm are reported

	Coefficients	*t*-stat
Lagged Return	−0.1356***	−6.49
Market Return	0.1662***	3.22
Size	0.0000	0.59
$DC_{i,k,t}$	−0.0004	−0.17
Intercept	Yes	
Industry fixed Effects	Yes	
N	2,248	
Adj. R^2	0.019	

Note(s): This table presents results from regression of return on market return, lagged return, size and $DC_{i,k,t}$ for pooled sample. $DC_{i,k,t}$ is the binary variable of zeros (and ones) that identifies the firms before (and after) obtaining B-corporation certification. *, ** and *** denote statistical significance at the 10, 5 and 1% levels, respectively

Table 5. Multivariate analysis of returns for pooled sample

Notes

1. Pickens acquired 20.2 percent of Koito Manufacturing Co. stocks and wanted to place three of his own executives on the board of directors. He failed to do so.

2. Australia was very keen on this point.

3. The authors would like to express their thanks to World Economic Forum, Strategic Intelligence for granting them permission to replicate the chart in Exhibit 1.

4. World Economic Forum, Strategic Intelligence, https://intelligence.weforum.org/topics/ a1G0X000005JLTqUAO

5. Fox (2019), Forbes, The Rise of Conscious Capitalism, https://www.forbes.com/sites/gretchenfox/ 2019/03/26/the-rise-of-conscious-capitalism/?sh56144dd5c139d

6. The Purpose of Corporate Governance, Business Roundtable, August 19, 2019. https://purpose. businessroundtable.org/

7. He relies on study posted by Saylor Academy (2012).

8. Democracy Now, January 2022.

9. Towards Accountable Capitalism: Remaking Corporate Law Through Stakeholder Governance Posted by Lenore Palladino and Kristina Karlsson, Roosevelt Institute, February

11, 2019.

10. Benefit corporations are different from certified corporations. A benefit corporation is a legal structure for business and is empowered to pursue positive stakeholder impact alongside profit. Some companies are both certified B-corporations and benefit corporations, if they fulfill the legal accountability requirements of B-certification.

11. For instance, via CRSP and Datastream, respectively.

References

Bofinger, Y., Heyden, K.J. and Rock, B. (2022), "Corporate social responsibility and market efficiency: evidence from ESG and misvaluation measures", *Journal of Banking & Finance*, Vol. 134, 106322, ISSN 0378-4266, doi: 10.1016/j.jbankfin.2021.106322.

Bridoux, F.M. and Stoelhorst, J.W. (2016), "Stakeholder relationships and social welfare: a behavioral theory of contributions to joint value creation", *Academy of Management Review*, Vol. 41 No. 2,

pp. 229-251.

Brulhart, F., Gherra, S. and Quelin, B.V. (2019), "Do stakeholder orientation and environmental proactivity impact firm profitability?", *Journal of Business Ethics*, Vol. 158, pp. 25-46, doi: 10.1007/s10551-017-3732-y.

Doerr, J. (2021), *Speed and Scale: an Action Plan for Solving Our Climate Crisis Now*, Portfolio (November 9, 2021).

Eesley, C. and Lenox, M.J. (2006), "Firm responses to secondary stakeholder action", *Strategic Management Journal*, Vol. 27, pp. 765-781.

Elias, A.A. (2017), "Systems thinking and modelling for stakeholder management", *IIM Kozhikode Society & Management Review*, Vol. 6 No. 2, pp. 123-131, available at: http://ksm.sagepub.com.

Fama, E.F. (2020), *Contract Costs, Stakeholder Capitalism, and ESG*, University of Chicago, Booth School of Business, Chicago, Booth Paper No. 20-46.

Fassin, Y. (2012), "Stakeholder management, reciprocity and stakeholder responsibility", *Journal of Business Ethics*, Vol. 109, pp. 83-96.

Ferres, D. and Marcet, F. (2021), "Corporate social responsibility and corporate misconduct", *Journal of Banking & Finance*, Vol. 127, 106079, ISSN 0378-4266, doi: 10.1016/j.jbankfin.2021.106079.

Fliaster, A. and Kolloch, M. (2017), "Implementation of green innovations – the impact of stakeholders and their network relations", *R&D Management*, Vol. 47 No. 5, pp. 689-700.

Fox, G. (2019), "The rise of conscious capitalism", *Forbes*, 26 March, available at: https://www.forbes.com/sites/gretchenfox/2019/03/26/the-rise-of-conscious-capitalism/?sh56144dd5c139d.

Goodman, Peter S. (2022), *Davos Man*, Custom House/Morrow, ISBN 10: 0063078309 (accessed 18

Jan 2022).

Gregory, A.J., Atkins, J.P., Midgley, G. and Hodgson, A.M. (2020), "Stakeholder identification and engagement in problem structuring interventions", *European Journal of Operational Research*, Vol. 283 No. 1, pp. 321-340, ISSN 0377-2217, doi: 10.1016/j.ejor.2019.10.044.

Hardin, W., Hurwitz, C. and Parhizgari, A.M. (2020), "Do real estate ETFs increase the volatility of REITs?", *Journal of Real Estate Research*, Vol. 42 No. 4, pp. 439-475, doi: 10.1080/08965803.2020.1844534.

Harrison, J.S. and Wicks, A.C. (2021), "Harmful stakeholder strategies", *Journal of Business Ethics*, Vol. 169, pp. 405-419, doi: 10.1007/s10551-019-04310-9.

Hester, P. (2015), "Analyzing stakeholders using fuzzy cognitive mapping", *Procedia Computer Science*, Vol. 61, pp. 92-97.

Hillenbrand, C., Money, K. and Ghobadian, A. (2013), "Unpacking the mechanism by which corporate responsibility impacts stakeholder relationships", *British Journal of Management*, Vol. 24,

pp. 127-146.

Jones, T.M., Harrison, J.S. and Felps, W. (2018), "How applying instrumental stakeholder theory can provide sustainable competitive advantage", *Academy of Management Review*, Vol. 43 No. 3,

pp. 371-391.

Laplume, A., Walker, K., Zhang, Z. and Yu, X. (2020), "Incumbent stakeholder management performance and new entry", *Journal of Business Ethics*, Vol. 174, pp. 629-644, doi: 10.1007/s10551-020-04629-8.

Lasicki, T. (2020), "The shareholder v. stakeholder contrast: a brief history", available at: https://medium.com/swlh/the-shareholder-v-stakeholder-contrast-a-brief-history-c5a6cfcaa111.

Miles, S. (2017), "Stakeholder theory classification: a theoretical and empirical evaluation of definitions", *Journal of Business Ethics*, Vol. 142, pp. 437-459, doi: 10.1007/s10551-015-2741-y.

Pedersen, L.H., Fitzgibbons, Sh. And Pomorski, L. (2021), "Responsible investing: the ESG-efficient Frontier", *Journal of Financial Economics*, Vol. 142 No. 2, pp. 572-597, ISSN 0304-405X, doi: 10.1016/j.jfineco.2020.11.001.

Pedrini, M. and Ferri, L.M. (2019), "Stakeholder management: a systematic literature review",

Corporate Governance, Vol. 19 No. 1, pp. 44-59, doi: 10.1108/CG-08-2017-0172.

Pirozzi, M. (2019), *The Stakeholder Perspective: Relationship Management to Increase Value and Success Rates of Projects*, CRC Press, Taylor & Francis Group.

Schneider, T. and Sachs, S. (2017), "The impact of stakeholder identities on value creation in issue-based stakeholder networks", *Journal of Business Ethics*, Vol. 144 No. 1, pp. 41-57.

Schwab, K. (2021), *Stakeholder Capitalism: A Global Economy that Works for Progress, People and Planet*, Wiley, 6 January 2021, ISBN: 978-1-119-75613-2.

Sigalla, O.Z., Tumbo, M. and Joseph, J. (2021), "Multi-stakeholder platform in water resources management: a critical analysis of stakeholders' participation for sustainable water Resources", *Sustainability*, Vol. 13, pp. 92-60, doi: 10.3390/su13169260.

Stretton, A. (2018), "A commentary on program/project stakeholders, commentary", *PM World Journal*, Vol. VII No. X, October.

Winkler, A.P., Brown, J.A. and Finegold, D.L. (2019), "Employees as conduits for effective stakeholder engagement: an example from B corporations", *Journal of Business Ethics*, Vol. 160, pp. 913-936, doi: 10.1007/s10551-018-3924-0.

World Economic Forum, Strategic Intelligence (2022), "Corporate governance", available at: https://intelligence.weforum.org/topics/a1G0X000005JLTqUAO.

Yang, J. and Basile, K. (2021), "Communicating corporate social responsibility: external stakeholder involvement, productivity and firm performance", *Journal of Business Ethics*. Doi: 10.1007/s10551-021-04812-5.

Zhao, L. and Parhizgari, A.M. (2021), "Climate change, technological innovation, and firm performance", *FIU Manuscript and Paper Presented at GFC 2021 and ICABE 2021*.

Further reading

Garriga, E. (2014), "Beyond stakeholder utility function: stakeholder capability in the value creation process", *Journal of Business Ethics*, Vol. 120 No. 4, pp. 489-507.

Jackson, K.V. (2011), "Towards a stakeholder-shareholder theory of corporate governance: a comparative analysis", *Hastings Business Law Journal*, Vol. 7 No. 2, 4, Summer, available at: https://repository.uchastings.edu/cgi/viewcontent.cgi?article51165&context5hastings_business_law_journal.

Martin, K. and Phillips, R. (2021), "Stakeholder friction", *Journal of Business Ethics*. Doi: 10.1007/s10551-020-04652-9.

Pirozzi, M. (2017), "The stakeholder perspective, featured paper", *PM World Journal*, Vol. VI No. VI, June.

CHAPTER 2

Does the ESG sector rescue responsible investors in a moment of turmoil? Evidence from the post-pandemic inflationary era

Alireza Dastan

Department of Management of Complex Systems, University of California Merced, Merced, California, USA

Abstract

Previous studies have assessed the effects of socially responsible investment (SRI) on portfolio performance. However, there is no significant evidence of SRI's resiliency during financial turmoil. In this empirical study, we aim to fill such a gap by examining 5873 companies in the top 25 largest economies (based on GDP) from Jan 2022 to November of 2023 (23 months). The results indicate either no significant or marginal positive role of SRI in portfolio performance.

1. Introduction

The world economy often being affected by the unexpected condition. In the current century, we have seen multiple incidents, from the Dot-Com bubble to the recent recession created by the COVID-19 pandemic and its aftermath, plus the invasion of Ukraine by Russia. While some economies managed to experience a milder slow-down, some had to go through a lengthy recovery period. Global markets saw a sharp crash at the beginning of the pandemic, known as the Great Lockdown, followed by a rapid recovery period. Highly loose monetary policies obtained by the central banks guaranteed the rebound. Examples include bailouts, crucial deduction of interest rates, printing money, etc. were among such policies. The previous bull run lasted from the end of March 2020 to the end of 2021. However, markets were affected by the astonishing inflation rates in 2022, urging central banks to tighten their policies and stop printing money.

From the aftermath of COVID-19 and the Ukraine war's perspective, the digital sector was the one to surge the most during the 2020-21 bull run (Ben-Hamed et al., 2021) and took a hit the most due to inflation. Also, the global markets for energy and food were among the most affected by the war and supply chain issues (Ari et al., 2022). Despite the loose monetary policies adopted by the US and EU and remarkably lower interest rates, companies were considered to have a higher cost of capital and riskier profiles. The sentiment in Chinese markets indicated a high level of fear during the pandemic (Vo, 2021; Ke, 2021; Caporin et al., 2021). All the mentioned literature above unanimously declares COVID-19 Pandemic as a significant threat to the world economies. Since responsible firms have shown higher loyalty and lower price-elasticity of demand (Albuquerque et al., 2020), it is necessary to investigate whether investing in companies with more sustainable and responsible approaches sheltered shareholders during the time of crisis or not.

SRI's effect on portfolio performance has been under scrutiny for different periods of financial turmoil. For instance, Lins et al. (2017) looked into such a phenomenon during the subprime crisis (from 2008 to 2009). Bae et al. (2021) and Nirino (2022) have done the same analysis for the pandemic in the US and European markets, respectively (from 2020 to 2021).

Each study shows different results. Lins et al. (2017) found that SRI can, in fact, protect investors. Bae et al. (2020) show no relation in the US, and Nirino et al. (2022) have claimed a slightly negative effect in Europe. All the contradicting outcomes highlight the necessity of a broader and more complex analysis.

2. Methodology

2.a. Data

The data and ESG scores were acquired from Bloomberg ESG Database. We examine 5873 publicly traded firms in the top 25 largest economies by GDP, such as the United States, China, Japan, Germany, United Kingdom, India, France, Italy, Canada, South Korea, Russia, Brazil, Australia, Spain, Mexico, Indonesia, Netherlands, Saudi Arabia, Turkey, Switzerland, Poland, Sweden, Belgium, Thailand, and Ireland. The ESG (Env/Soc) ratings are the latest up to the end of 2021. Only large-cap firms (over $500 million) and the largest economies are included to achieve more rigorous results.

2.b. Models and variables

We have looked into the firms' share price resiliency during the inflation era of 2022-2023, precisely the first twenty-three months. To dig deeper into the specifics of the firms' ESG branding, the environmental and social components are separated from the comprehensive ESG scores. Also, apart from the return, overall companies' strengths are quantified by various variables, including market cap, long-term debt, short-term debt, liquidity, operating income, book-to-market ratio, and most importantly, each firm's momentum before the crisis.

The two models (6 situations) are created to distinguish between raw-return-only incorporated vs. market-adjusted models with three types of analyses (ESG score, Social score, Environmental score).

Analysis of market-adjusted stock performance (P_{ESG}) by ESG rating:

$$\mathbf{P_{ESG}} = \beta_1 ESG + \beta_2 LMC + \beta_3 LD + \beta_4 SD + \beta_5 L + \beta_6 OI + \beta_7 BM + \beta_8 N//BM + \beta_9 M + \beta_{10} LCC + e$$

Analysis of market-adjusted stock performance (P_{Env}) by Environmental rating:

$$\mathbf{P_{Env}} = \beta_1 ESG + \beta_2 LMC + \beta_3 LD + \beta_4 SD + \beta_5 L + \beta_6 OI + \beta_7 BM + \beta_8 N//BM + \beta_9 M + \beta_{10} LCC + e$$

Analysis of market-adjusted stock performance (P_{Soc}) by Environmental rating:

$$\mathbf{P_{Soc}} = \beta_1 ESG + \beta_2 LMC + \beta_3 LD + \beta_4 SD + \beta_5 L + \beta_6 OI + \beta_7 BM + \beta_8 N//BM + \beta_9 M + \beta_{10} LCC + e$$

Country (sorted by GDP)	Number of Observations	%	Country (sorted by GDP)	Number of Observations	%
United States	2418	41.17%	Spain	59	1.00%
China	658	11.20%	Mexico	42	0.72%
Japan	418	7.12%	Indonesia	40	0.68%
Germany	164	2.79%	Netherlands	59	1.00%
United Kingdom	332	5.65%	Saudi Arabia	24	0.41%
India	125	2.13%	Turkey	43	0.73%
France	137	2.33%	Switzerland	112	1.91%
Italy	70	1.19%	Poland	25	0.43%
Canada	300	5.11%	Sweden	139	2.37%
South Korea	134	2.28%	Belgium	42	0.72%
Russia	39	0.66%	Thailand	87	1.48%
Brazil	106	1.80%	Ireland	44	0.75%
Australia	256	4.36%	**TOTAL**	5873	

Table 1. Firm Observations per Country

Variable	Description
ESG	ESG Score
Env	Environmental score
Soc	Social score
LMC	Natural log of market cap
LD	Long-term debt
SD	Short-term-debt
L	Liquidity
OI	Operating income
BM	Book to Market ratio
N//BM	Negative BM: dummy=1, if positive; 0 if negative
M	Momentum or Raw 2021 Return
LCC	Natural log of country cases
P	Return during the crisis

Table 2. Variable description for the market-adjusted analysis (Model II)

3. Empirical Results

3.a. Raw Return (Model I)

In the non-market-adjusted analysis, we model the situation by including the ESG (Env/Soc) score plus fixed company and country effects. The raw return during the crisis is -28.7%, slightly better than -31.9% achieved by Nirini et al. (2022) and -39% by Bae et al. (2021).

The model I shows a positive yet statistically insignificant role of ESG (Env/Soc) scores. These results are compatible with the study by Nirino et al. (2022) and Bae et al. (2021).

3.b. Market-adjusted (Model II)

In this model, we investigate the stock performance using market-specific features plus fixed company and country components.

By incorporating the market-adjusted variables, Table 3 indicates the correlation matrix. The correlations between ESG variables are negligible, which shows no sign of endogeneity.

Our results show a marginally positive and significant effect of ESG (Env/Soc) scores during the crisis, which is compatible with Lins et al. (2017) and Bae et al. (2021), and contradictory to Nirino et al. (2022).

4. Discussion

4.a. Emergence of SRI

There are various works on the efficacy of SRI on portfolio performance. There is also a limited specification of the financial structures or innovation needed to achieve the Sustainable Development Goals (SDG). The expected cost of achieving all the SDGs across the globe ranges between 2.5 trillion USD per year (estimated by the UN Conference on Trade and Development, UNCTAD, 2020) to 5.0 trillion USD per year (estimated by the Basel Institute of Commons and Economics; Dill, 2018). The primary source of finances should be government debt from developed countries. However, the Rockefeller Foundation alternatively suggested that the solution might instead lie amid the 200 trillion USD in annual private investing transactions, presumably through SRI in firms that show strong ESG profiles and a likelihood of future profits. SRI will require creative thinking and reliable metrics to quantify the companies' determination to achieve SDGs. Firms that take SDG risk seriously are also mitigating the financial risk from adverse SDG events, and there are some, albeit conflicting, studies showing a correlation between profitability and respect for SDGs. Nonetheless, we have yet to agree-upon reliable metrics for SDG compliance.

ESG teams in the asset management industry have grown 230%, with socially responsible investing (SRI) growing from 22.9 trillion USD in 2016 to over 40 trillion USD in 2020, according to a 2020 Optimas report. The Global Sustainable Investments Review states that SRI grew from 8.7 trillion USD in 2016 to 12.0 trillion USD in 2018. SRI totals 44% of the total financial market investments worldwide and 26% of assets under professional management in the US. This number has increased by 38% from 2016.

Although private equity (PE) firms usually struggle with finding attractive risk-reward premiums (Knight, 2010), we see more PEs are throwing their hats in the ring by backing the proclaimed ESG-compliant companies (MacArthur et al., 2020). Returns, along with ethics, regulations, and public relevancy, are repeatedly mentioned as the incentives for SRI. However, we believe the recent investment rush also stems from the shared risk profiles between a larger pool of investors.

Variable	ESG	Env	Soc	LMC	LD	SD	L	OI	BM	N//BM	M	LLC	P
ESG	1												
Env	0.84	1											
Soc	0.89	0.68	1										
LMC	0.55	0.34	0.40	1									
LD	0.08	0.53	0.66	0.07	1								
SD	0.05	0.41	0.08	-0.18	-0.06	1							
L	-0.32	-0.02	-0.32	-0.20	-0.07	-0.20	1						
OI	0.14	0.25	-0.04	0.17	0.14	0.03	0.03	1					
BM	0.05	0.11	0.09	-0.01	-0.36	-0.07	0.16	0.06	1				
N//BM	0.01	-0.03	-0.21	-0.14	0.05	-0.23	-0.21	0.14	0.01	1			
M	-0.11	-0.07	0.12	0.06	0.02	-0.10	-0.06	-0.17	-0.02	-0.17	1		
LCC	0.02	-0.22	0.16	0.24	0.09	0.08	0.01	0.00	-0.11	0.03	0.05	1	
P	**0.05**	**0.06**	**0.00**	**0.13**	**-0.31**	**0.01**	**0.08**	**0.06**	**-0.07**	**0.05**	**0.01**	**0.04**	**1**

Table 3. Correlation Matrix

4.b. Urgency for reliable and standard metrics

Aiba, Ito, & Ibe (2019) performed a correlation analysis of the two most prominent, the FTSE Russell and MSCI, for 526 Japanese companies' ESG scores at the end of February 2019. The broad spread of the results reveals a low correlation with the upper left and bottom right corners representing the nearly opposite ESG scores (see Figure 1). Tesla, for example, was given one of the highest rankings from MSCI but one of the lowest from FTSE (Lohr, 2019). Correlations between other ESG industry scorers, like Bloomberg, RobecoSAM, and Sustainalytics, do not fare much better (State Street Global Advisors, 2019), as seen in Figure 2.

Therefore, the large and growing asset sums beg for an accurate metric for investment managers to undertake quality assessments about potential investment targets. However, making decisions involves operating in a quagmire of uncertain ESG targets, difficulty assessing the UN's SDG targets, uneven ESG self-reporting from companies, and a hodge-podge of assessment tools and services with divergent assessment results.

The Global Reporting Initiative (GRI) is the most popular reporting framework, developed by the Global Sustainability Standards Board in Amsterdam and affiliated with the UN Environment Program and the UN Global Compact. Although the first framework was developed earlier in the US, a more mature second version was released at the 2000 Rio+10 conference in Johannesburg. According to the KPMG Survey of Corporate Responsibility (2017), 75% of the global fortune 250 companies now use the GRI reporting structure, making it the most used ESG internal report.

In addition, the European Union Directive (EU) 2016/2341, the Institution on Occupation and Retirement Provision (IORP), which specifies the regulation for pension and retirement funds, made clear that ESG factors are to be taken into consideration for fund risk management. The beneficiaries' long-term interests are prioritized as it relates to the ESG concerns.

Variable	ESG				Env				Soc			
	Model I		Model II		Model I		Model II		Model I		Model II	
	Coef.	T-value	Coef.	T-value	Coef.	T-value	Coef.	T-value	Coef.	T-value	Coef.	T-value
Rating	-0.0002	-0.89	0.0003**	2.56	0.004	0.23	0.0014**	3.38	0.008	0.17	0.0043**	1.21
LMC	-	-	0.016***	4.32	-	-	0.00247***	5.21	-	-	0.0021	5.79
LD	-	-	0.0934**	2.55	-	-	-0.793***	-0.97	-	-	0.0441**	2.98
SD	-	-	-0.0074	-1.96	-	-	0.0024	2.41	-	-	0.2133*	0.77
L	-	-	0.0353	0.77	-	-	0.0544**	0.68	-	-	0.0311	0.79
OI	-	-	-0.418	-1.98	-	-	-0.1471***	-0.46	-	-	-0.0361**	-3.42
BM	-	-	0.003**	0.21	-	-	-0.35	-0.03	-	-	-0.146	-2.17
N//BM	-	-	0.0126	1.84	-	-	0.0521*	0.041	-	-	0.0127	0.08
M	-	-	0.027*	2.69	-	-	0.0327	3.15	-	-	0.0313	0.78
LCC	-	-	0.071	8.73	-	-	3.059	16.44	-	-	5.0641**	8.22

Table 4. The effect of each score during the crisis period.

The US lacks such requirements at the government level but has many signatories on the UN-established Principles for Responsible Investment (PRI), which seeks to promote ESG-related concerns and foster support to enable such concerns.

SRI's inability to protect investors during financial crises seems to be the problem of not having a clear and unified method to quantify firms' commitment to adopting ESG criteria.

5. Conclusion

We examined the ESG-compliant companies in the top 25 largest economies and found that SRI, with the current contradictory standards and regimen, has no remarkable effect on protecting portfolios. Our results were significant, but the effect of SRI on portfolio performance was negligible. Other studies also showed a trivial effect, although with no statistical significance.

We believe using Artificial Intelligence is the critical solution to recognize and distinguish ESG-committed firms from corporate dishonesty and greenwashing.

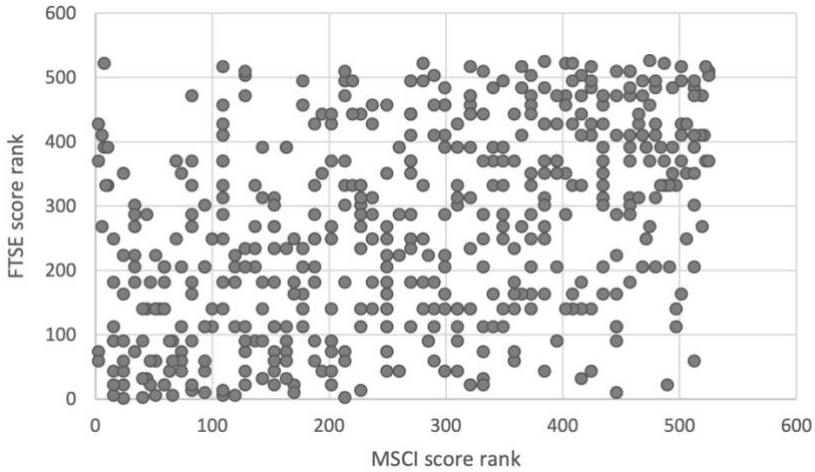

Figure 1. FTSE vs. MSCI ESG score correlation by © Aiba, Ito, & Ibe (2019)

	Sustainalytics	MSCI	RobecoSAM	Bloomberg ESG
Sustainalytics	1	0.53	0.76	0.66
MSCI		1	0.48	0.47
RobecoSAM			1	0.68
Bloomberg ESG				1

Figure 2. From © State Street Global Advisors, ESG rankings correlations, The ESG Challenge, 2019

References

Aiba, Y., Ito, T., & Ibe, Y. (2020). *Network Structure in ESG Ratings Suggests New Corporate Strategies: Evolving AI Technology to Quantify Qualitative Data*. 16.

Albuquerque, R., Koskinen, Y., Yang, S., Zhang, C., 2020. Resiliency of Environmental and Social Stocks: An Analysis of the Exogenous COVID-19 Market Crash. The Review of Corporate Finance Studies 9, 593–621.

Ashraf, B.N., 2021. Stock markets' reaction to Covid-19: Moderating role of national culture. Finance Research Letters 41, 101857.

Bae, K.-H., El Ghoul, S., Gong, Z. (Jason), Guedhami, O., 2021. Does CSR matter in times of crisis?

Evidence from the COVID-19 pandemic. Journal of Corporate Finance 67, 101876.

Ben-Ahmed, K., Ayadi, I., Hamad, S.B., 2021. COVID-19 impact on digital companies' stock return: A dynamic data analysis. Finance Research Letters 102340.

Brammer, S., Brooks, C., Pavelin, S., 2006. Corporate Social Performance and Stock Returns: UK Evidence from Disaggregate Measures. Financial Management 35, 97–116.

Cao, K.H., Li, Q., Liu, Y., Woo, C.-K., 2021. Covid-19's adverse effects on a stock market index. Applied Economics Letters 28, 1157–1161.

Caporin, M., Garcia-Jorcano, L., Jimenez-Martin, J.-A., 2021. Measuring systemic risk during the COVID-19 period: A TALIS3 approach. Finance Research Letters 102304.
Cowen, S.S., Ferreri, L.B., Parker, L.D., 1987. The impact of corporate characteristics on social responsibility disclosure: A typology and frequency-based

analysis. Accounting, Organizations and Society 12, 111–122.

Ke, Y., 2021. The impact of COVID-19 on firms' cost of equity capital: Early evidence from US public firms. Finance Research Letters 102242.

Knight, E. R. W. (2011). Five Perspectives on an Emerging Market: Challenges with Clean Tech Private Equity. *The Journal of Alternative Investments*, *14*(3), 76–81.

Lins, K.V., Servaes, H., Tamayo, A., 2017. Social Capital, Trust, and Firm Performance: The Value of Corporate Social Responsibility during the Financial Crisis: Social Capital, Trust, and Firm Performance. The Journal of Finance 72, 1785–1824.

Lohr, S. (2019). A Lesson of Tesla Crashes? Computer Vision Can't Do It All Yet. *The New York Times*, 7.

MacArthur, H., Bierly, C., van den Branden, J.-C., Steclik, I., Dessard, J., & Seemann, A. (2020, February 24). *Investing with Impact: Today's ESG Mandate in Private Equity*. Bain.

Nirino, N., Petruzzella, F., Alam, G.M. and Campobasso, F. (2022), "Can sustainable practices protect investors during financial market instability? A multi-sector analysis during the COVID-19 pandemic", *Management Decision*, Vol. 60 No. 10, pp. 2875-2894.

Nollet, J., Filis, G., Mitrokostas, E., 2016. Corporate social responsibility and financial performance:

A non-linear and disaggregated approach. Economic Modelling 52, 400–407.

Salman, A., Ali, Q., 2021. Covid-19 and its impact on the stock market in GCC. Journal of Sustainable Finance & Investment 1–17.

Shahrokhi, M., Parhizgari, A. M., Hashemijoo, M., Okafor, C. E., Nishikawa, Y., & Dastan, A. (2022). Corporate governance and stakeholder capitalism. *Managerial Finance*, *ahead-of-print*

Subramaniam, S., Chakraborty, M., 2021. COVID-19 fear index: does it matter for stock market returns? RBF 13, 40–50.

Surroca, J., Tribó, J.A., Waddock, S., 2010. Corporate responsibility and financial performance: the role of intangible resources: Intangibles, Corporate Responsibility, and Financial Performance. Strat. Mgmt. J. 31, 463–490.

Topcu, M., Gulal, O.S., 2020. The impact of COVID-19 on emerging stock markets. Finance Research Letters 36, 101691.

UNCTAD. (2014). *Developing countries face $2.5 trillion annual investment gap in key sustainable development sectors, UNCTAD report estimates | UNCTAD* Wang, Z., Sarkis, J., 2017. Corporate social responsibility governance, outcomes, and financial performance. Journal of Cleaner Production 162, 1607–1616.

USSIF. (n.d.). *Sustainable Investing Basics*. The Forum for Sustainable and Resonsible Investment. Retrieved December 1, 2021, from https://www.ussif.org/sribasics

Vo, T. T. A., & Mazur, M. (2022). The effect of investor protection on firm riskiness and performance during the COVID-19 economic crisis. *Applied Economics Letters*, 1-11.

Wu, G., Yang, B., Zhao, N., 2020. Herding Behavior in Chinese Stock Markets during COVID-19. Emerging Markets Finance and Trade 56, 3578–3587.

CHAPTER 3

How AI Affects the Future Relationship Between Corporate Governance and Financial Markets: A Note on Impact Capitalism

Russ McBride*
Russ.McBride@ucmerced.edu
and
Alireza Dastan
adastan@ucmerced.edu
Department of the Management of Complex Systems
University of California, Merced

Poorya Mehrabinia
p.mehrabinia@arizonastate.edu
Eller College of Management
University of Arizona

Abstract

We examine the dynamics between corporate governance and financial markets and how AI can facilitate and incentivize sustainability reform in different ways. Based on a qualitative review of over 100 pieces of literature, we offer an outlook into the mentioned dynamics through the lens of complex systems. In a closed system, there is a reinforcing feedback loop between socially responsible investment (SRI) and corporate social responsibility (CSR). AI is a moderator to increase SRI and a mediator to incentivize CSR. Legal and ethical provisions for safe and robust AI systems are briefly discussed.

Keywords: corporate governance, ESG, corporate social responsibility, SDG, artificial intelligence, socially responsible investment

1. Introduction

There is increasing interest and effort to establish sustainable activities for the environment (E), improve social wellbeing (S), and encourage fair governance structures (G) across the globe (ESG). There is also an increasing realization that countries are more interconnected, and that climate, social problems, and governance approaches in one part of the world often have widespread repercussions.

However, the fact that a distant ESG problem *might*, through a series of cause-and-effects, wend its way to a firm or the bank that finances that firm is unlikely to be enough to motivate most firms to act. 2030 is the year that (most of) the sustainable development goals (SDGs) of the United Nations (UN) are due—17 goals related to addressing ESG issues. These goals pose enormous challenges to the signatory countries and achieving the SDGs, which will require changes to government policy, non-profits, and non-governmental organizations (NGOs) and changes that must extend to companies, tech firms, cultural norms, and the entire financial industry. Thus, despite the potentially limited endogenous motivation that a firm might have to abide by the SDGs, AI can facilitate some degree of motivation and grass-roots requests from consumers, investors, and other stakeholders demanding greener, more sustainable, and socially responsible businesses. Firms are changing and, with it, their governance regimes and shareholders.

Corporations have been attracting investors' attention through various methods. First, by issuing green bonds, and raising debt as compensation for the cost of reform. Second, by announcing greater transparency under corporate sustainability reporting directive (CSRD) and sustainability accounting standards board (SASB). In the short run, the stock market responds positively to such attempts, and in the long run, they achieve superior accounting performance, labor productivity, employee satisfaction, sales growth, and abnormal returns (Flammer, 2015; Flammer, 2021; Shahrokhi et al., 2022). Therefore, corporate social responsibility (CSR) causes higher financial strength, productivity, and success in private and public corporations, which means a higher reward and lower risk for the shareholders. Thus, *in a closed system,* investment amounts and frequency rise while returns get larger. Such momentum results in better incentives for corporations, more entrepreneurs and boardrooms stepping up, and more companies becoming ESG compliant; hence more investment opportunities arise. Therefore, we can expect a reinforcing positive feedback loop between SRI and CSR (see Figure 1).

Figure 1. The positive reinforcement between SRI and CSR

The primary goal of the “C-Team” (CEO, CFO, CIO, COO) and top management to always maximize profit and always increase shareholder value is being reconsidered (Stout, 2012). Nevertheless, the incentive structures, the accounting systems, and the governance structures have been refined over a long evolution. It is challenging to fathom what changes need to be made to the well-established reporting and accounting systems to incorporate ESG goals, much less the measurement and implementation of

such across a firm. Indeed, for a firm to even get a clear understanding of what SDGs might be relevant to track or target is non-trivial.

This is where, for many, artificial intelligence (AI) enters the picture. AI has been mentioned frequently as a solution or future solution to many aspects of these challenges, not just the environment but also the social and governance challenges. In what follows, we discuss the dynamics of the relationship between SRI and CSR and how AI affects such dynamics. Taken together, this should provide an overall idea about the degree to which AI systems, developed internally by firms or third parties, can help achieve a more responsible corporate governance and know which provisions are compulsory to ensure ethical and legal compliance.

Other than purely altruistic or regulatory compliance reasons, why would a firm or an investor make complex and challenging changes toward becoming more ESG-friendly or invest in expensive AI development to facilitate becoming more ESG-friendly? In short: because it is also in their self-interest.

2. AI-Based ESG Assessment

Why use AI for responsible investment? The mass institutional investment, regardless of its will for participating in the collective action towards responsibility in asset allocation, suffers from a paucity of high-quality data, opaque performance metrics (Black Box issue), and inability to predict extreme events (Ito, 2020; Selim, 2020). Investors often lack confidence in ESG asset allocation as the standards and ratings easily vary and are often non-correlated among different rating agencies.

There are a host of problems relying upon the self-disclosures of firms themselves. (1) The incentive to bias their reporting—the greenwashing problem. Self-reporting data are often subject to bias, mainly for greenwashing purposes. Firm-level sustainability reports only project adopted policies and goals instead of focusing on the actual performance with no links to firms' actual financial wellbeing. Even if company reports are fair and non-biased, the data is not real-time, and the frequency might be as low as one or a few per annum (Antoncic, 2020a). There is not much rigor to help realize suitable investments and benchmarks. (2) The larger firms have more generous budgets with which to build their ESG disclosure statements and do so in a beneficial way to themselves. This unfair advantage makes the larger firms look more ESG-compliant because they have larger budgets to build their ESG materials. (3) The lack of standardization around the format of the disclosure statements. While most startups and universities strive to build more accurate ESG measuring tools, they lack the will to establish better standardized internal reporting structures. The financial markets demand accurate ESG ratings to guide investment decisions and provide targets for firms to improve their ESG ratings. In what follows, we want to look at a few of the most promising current solutions. All of them rely upon the UN SDGs.

Aiba et al. (2020) from Nomura Securities have not developed an ESG assessment system but rather a system that attempts to predict *the FTSE and MSCI rankings via standard AI NLP techniques*. Presumably, this could be used by the firms wishing to improve their ratings.

There has been a surge in natural language processing libraries that try to glean an understanding of 'sentiment' and even how a firm or person relates to certain concepts just by analyzing mountains of 'alternative data'—online articles, blogs, news pieces, social media pieces, and mentions of that firm. For an overview of this approach, see Peterson (2016). Aiba et al. (2020) use the NLP AI libraries (specifically the TF-

IDF algorithm) to process large amounts of information, including the company's disclosures. Such attempts aim to assess the degree to which the FTSE and MSCI indicators match the top ten GRI indicators to predict the FTSE and MSCI ratings. They have made some progress with an average regression coefficient of about 0.48.

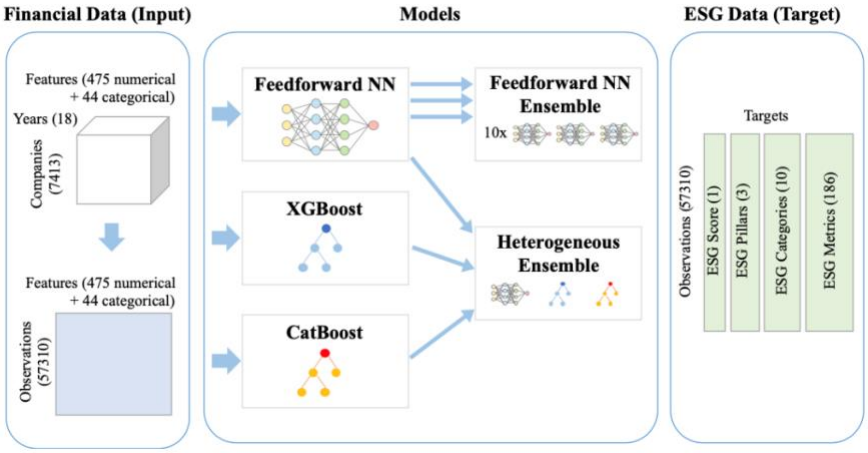

Figure 2. From an overview of the AI ensemble model used by Krappel et al. (2021).

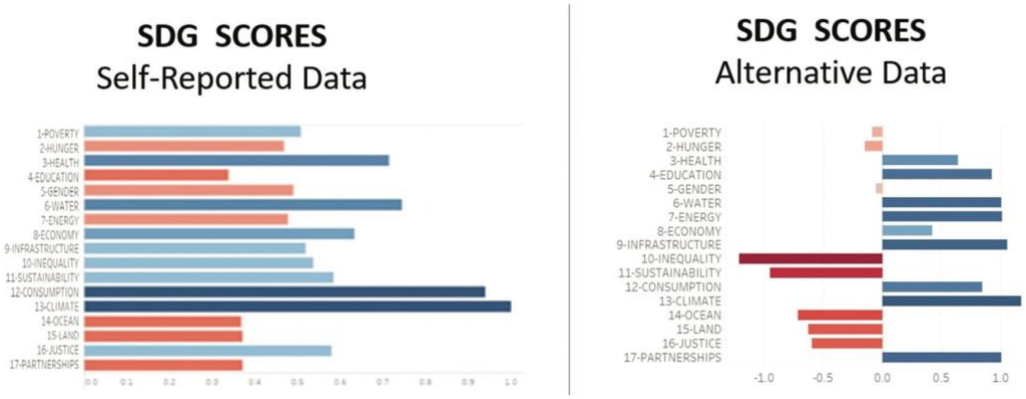

Figure 3. From Global AI Co., Antoncic (2020a) shows the changes to SDG scores when considering the negative scores

Krappel, Bogun, and Borth (2021) have used more advanced AI techniques to develop a system to predict the firms' ESG scores. They created different models, but the most accurate that explained a 54% variance in ESG scores was an ensemble model, a CatBoost system, an XGBoost system, and a regular feed-forward neural network (of the kinds based upon the original perceptron, see Figure 2). Their work is impressive. However, the "ESG controversies" (e.g., scandals, litigations, et Cetra) are not part of their analysis in the same manner as they are not part of ESG scoring by rating agencies (p2). This absence is a problem for the rating agencies and any assessment since most ESG problems are discovered through investigative reporting and social media posts easily discoverable through NLP searches. Failing to take note of a toxic spill or labor violation could make for a critical difference in an ESG rating.

Antoncic (2020a) recommends a similar AI system, but one that accounts for negative scores (failed to consider by corporations) as well as positive scores using

alternative data to track the 231 unique SDG indicators. Tracking negative scores is critical (see figure 3).

The basic approach is analogous to others, “using AI, machine learning and NLP to cull through tens of thousands of news items, social media, and reports in dozens of languages, providing up-to-date information going beyond what is present in unaudited, self-reported annual firm reports or firms' marketing efforts" (p109). Other than the reasonable suggestion to utilize negative indicators, she suggests building a model that assesses the UN's SDG indicators in parallel with a reporting standard developed from the UN's Conference on Trade and Development, which, through a working group, created a collection of Global Core Indicators (GCI's) to track the seventeen UN SDGs.

These tools, and hopefully more advanced ones in the future, can be beneficial mainly for the investors since they cast light on the inherent activities of the corporations and facilitate more assertive asset allocation regarding ESG criteria. Although, corporations can utilize such tools to self-assess and strategize as well. Based on the reviewed literature, we can develop the mentioned model in Figure 1 and call the third-party AI systems the moderator or catalyst, which offer more precise metrics for investment on the responsible corporations (see Figure 4). It is important to note that this is based on a qualitative assessment of the prior literature. However, the inherent complexity of the mentioned relationship requires further quantitative investigations to measure this system's scopes, specific attributes, and thresholds.

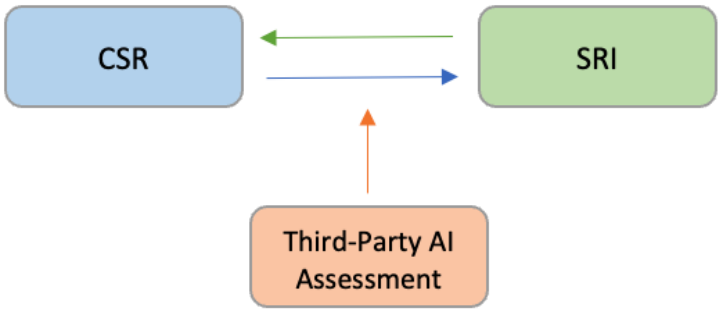

Figure 4. Third-party AI tools as the moderating factor for responsible asset allocation.

3. Strategic Governance Using AI

Corporate leadership can also benefit from self-developed AI systems in various ways. One mentioned merit is 'reputational footprint,' which lowers their cost of capital and gives them a competitive advantage. Besides, AI can offer solutions to manage macro systemic risks (Antoncic, 2020b). Meanwhile, delegating governance decisions fully to AI, i.e., 'co-governance' with AI can lead to severe illegal and non-ethical consequences (Hickman and Petrin, 2021). AI systems with advisory roles to the executives have multiple advantages and disadvantages. The merits can enable shareholders to engage more with the corporate strategies. In this manner, a well-developed system can bring transparency and mitigate short-termism. As a result, the executive decisions would enhance sustainability in the long-term economic realm. Therefore, shareholders feel heard and more involved in the management and are more likely to buy and hold the shares. Also, Big Data and AI-driven systems can enable the

executives to be flexible and focus on emerging values faster. On a side note, leadership would benefit from diverse ideas and perspectives (Lee and Underwood, 2021). Thus, widespread use of AI and integrating stakeholders' data will emerge more accurate decisions based on ESG criteria aligning with the most crucial stakeholders' values. AI can also incorporate the company's data and evaluate the managers' performance and governance. Hence, targeted responsible investment and imposing ESG criteria on corporations can result in firms' tendency to use AI systems to better their governance regime.

For strategic governance, both third-party and company's self-developed AI systems could be effective if all ethical and legal concerns are fully considered. However, there is no consensus yet to realize which one is more beneficial and feasible. Thus, AI systems act as the mediator for corporate reform since their existence can have a massive influence on better ESG-compliant corporate governance through higher investment demand (see Figure 5). It is necessary to note that the firm-developed AI systems are not to use for marketing purposes and merely for strategizing and measuring the governance metrics within each corporation, and therefore, the self-reporting bias is not going to be a problem using such systems.

4. Ethical and Legal Provisions

With all mentioned possible benefits of AI systems, we cannot ignore their threats and disadvantages. AI itself can put a toll on climate change as one large NLP training can potentially cause almost 300 tons of CO_2 emissions (Strubell et al., 2019). Also, quantifying the overall cost of large-scale AI systems is too complex to predict now (Crawford and Joler, 2019). Apart from the impact of AI on climate change, there are more provisions needed to be considered to create non-threatening AI systems. We know that AI has already paved its way towards being a full-autonomous board member in some companies (A VC in Hong Kong, for instance), according to a report by Business Insider (2014). However, using full-autonomous AI systems can impose harmful consequences on some stakeholders.

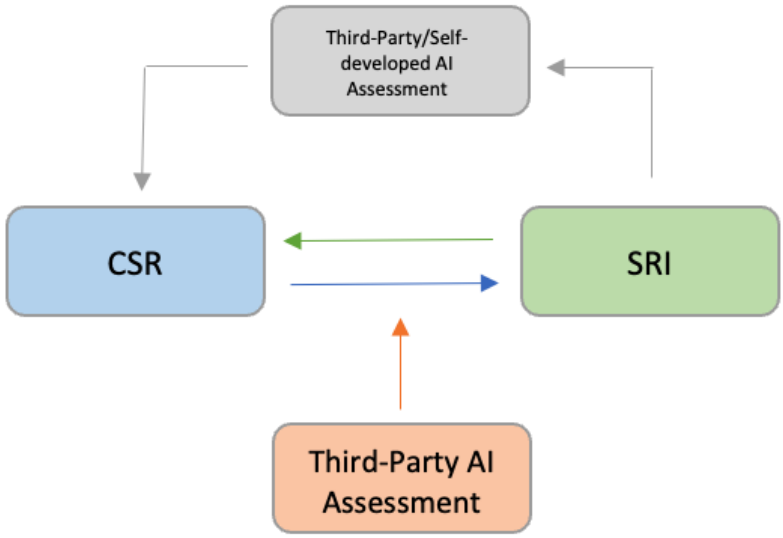

Figure 5. Third-party or firm-developed AI systems as mediators for corporate governance reform.

The firms delegating entire decision-making to AI can expect prospective lawsuits. AI can be useful merely in advisory roles, and complete autonomy is not

socially and, in many cases, legally accepted. Therefore, the EU has published a set of Guidelines 'the expert group's policy and investment recommendation for trustworthy AI. While the regulations are lagging, the guidelines can be a helpful lead until more robust legislation emerges. The guideline has seven criteria, in which AI systems must be developed with consideration of human agency, technical robustness, privacy and data governance, transparency, diversity and fairness, societal and human wellbeing, and accountability (Hickman and Petrin, 2021).

Besides ethical and legal concerns regarding the use of improper AI systems by the corporations, investors also pose a threat to the market efficiency if their algorithms are built for market manipulation, for which the person or entity responsible for creating such systems may not be held liable under the current US regulatory frameworks (Scopino, 2015). As Angel and McCabe (2013) list some market manipulating techniques, AI trading might be used for "Spoofing, Wash Sales, Quote Stuffing, Front Running, and other order triggering strategies." Automated trading can also lead to higher market volatility due to the higher frequency of taking and closing positions (Zhang, 2010).

5. Discussion

The developed model integrates over 100 scientific works, a qualitative assessment of the literature in corporate law, corporate governance, AI and data governance, asset pricing, and asset allocation. Nevertheless, the scopes, specifics, and thresholds should be tested and quantified.

As it may be noticed, we have not discussed the advantages of AI systems developed by investment firms. This exclusion is because of the lack of proper and strict regulation on such systems in which the creators are not held liable in the US courts if the AI algorithms are used for market manipulation. Therefore, we could not be convinced of such systems' benefits in incentivizing responsible governance.

Currently, Big Data and AI, using advanced statistical methods and algorithms, can eventually and gradually solve ESG assessment issues by:

1. Digging through the ocean of real-time news and social media posts and reports to tackle the data frequency issue, in which further provision will be needed for fact-checking and flagging fake or misleading news.
2. Provide statistical indicators and metrics to create a benchmark for tracking SDG progress and footprint.
3. Bringing back transparency to the table and making firms struggle to report falsely, greenwash, and abstain from excluding undesirable facts. Therefore, capital supply can regain its confidence (Antoncic, 2020a).

The strengths of natural and artificial intelligence are complementary. Humans routinely and fluently operate in volatile, uncertain, complex, and ambiguous (VUCA) environments that present significant hurdles for current paradigms of AI (Dehaene, 2020; Marcus & Davis, 2019; Mitchell, 2009). AI, on the other hand, can easily outperform even expert humans on computationally challenging tasks requiring parallel attention, decision making attuned to large volumes of relevant information, evaluation of complex trade-offs, and real-time control, as demonstrated by recent advances with DeepMind (e.g., Silver et al., 2017). The augmented human-AI systems could gradually enhance decision-making performance using continuously AI-generated data for ESG

categories, which would lead to higher policy-making and strategizing confidence and the willingness for investors to join the collective action towards sustainability (Lee & Zhang, 2019).

Still, challenges remain. The single largest one is that artificial intelligence is not yet intelligent; it does not understand the concepts of the terms it is manipulating. It does not understand what a 'rose' or ‘employee’ is, much less an ESG compliance term like 'sustainable .' This problem of accurate understanding in AI will not be solved anytime soon. The statistical and AI techniques were deployed effectively to work around this significant limitation.

Moreover, it is essential to be honest about the dangers of information manipulation, whether AI is handled or not. As Brusseau says (2020):

"The perils of AI and human interaction are not captured well by standard ESG criteria. Instead of environmental toxins, institutional corruption, or poverty, the most immediate risk produced by the artificial intelligence economy is our dataset. It is the information defining who we are – our habits, anxieties, beliefs, desires – that may be engineered to provide gratifying experiences and opportunities, but that also can be twisted to control where we go and what we do (p2)."

While some claim the threats of AI revolve around unrealistic discussions of rogue AI 'Terminator worlds,' the most prominent threat is the one we have already been battling that Brusseau describes: using AI and the massive amounts of information available about us to manipulate our behavior in ways, we do not want. In the future, there will be billions of dollars at stake for a company in an ESG assessment model that tweaks or does not tweak one small parameter that determines the assessment ranking. The assessment models must be developed somewhat without the influence of the manipulation described above.

Even when used for good, biases in the data can creep into biases in the AI model. For instance, we can name AI-racism in loan application processes as the data might be automatically biased towards white males and couples. Data scientists are only just now realizing the extent to which unknown aspects of the composition of the AI training data can have adverse outcomes. NLP systems must decipher the facts from fake news in reports and industry journals to achieve accurate ESG assessments.

Further, without open-sourcing the systems that perform the assessments, it is hard to know how they work. Even with open-sourced system, there is no way to "look inside" a deep learning system and understand how it made the assessment because there are just a series of mathematical transformations that are ultimately not human-readable. In the GOFAI (good old-fashioned AI) outdated systems, one could read the programming code and see what expert rules were used to arrive at the final assessments. This is impossible in machine learning systems where one can find only a matrix of numbers that represent the weights between the nodes.

We believe future work will continue along the three systems discussed and incorporate more than simple NLP and natural language processing libraries while including negative scores. Most assessment models have yet to catch up to more recent AI techniques. Like the Krappel et al. work, we suspect that they will more frequently begin to include generative adversarial networks (GANs) blended into more prosperous "ensemble" systems that incorporate a wider variety of tools. Ensemble systems have won most of the recent AI image recognition contests and currently seem to offer the most hope for a reliable ESG assessment system of the future. It bodes well for a future

ESG assessment system that will evolve into a more robust and accurate tool. Such systems not only help accelerate the change toward ESG-friendly companies but make the world a better place.

References

Aiba, Y., Ito, T., & Ibe, Y. (2020). *Network Structure in ESG Ratings Suggests New Corporate Strategies: Evolving AI Technology to Quantify Qualitative Data*. 16.

Angel, J. J., & McCabe, D. (2013). Fairness in financial markets: The case of high frequency trading. *Journal of Business Ethics*, *112*(4), 585–595.

Antoncic, M. (2020a). Uncovering hidden signals for sustainable investing using Big Data: Artificial intelligence, machine learning and natural language processing. *Journal of Risk Management in Financial Institutions*, *13*(2), 106–113. Business Source Complete.

Antoncic, M. (2020b). A paradigm shift in the board room: Incorporating sustainability into corporate governance and strategic decision-making using big data and artificial intelligence. *Journal of Risk Management in Financial Institutions*. https://hstalks.com/article/5961/a-paradigm-shift-in-the-board-room-incorporating-s/

Brusseau, J. (2021). AI human impact: Toward a model for ethical investing in AI-intensive companies. *Journal of Sustainable Finance & Investment*, 1–28. https://doi.org/10.1080/20430795.2021.1874212

Crawford, K., & Joler, V. (2018). Anatomy of an AI System. *Retrieved September*, *18*, 2018.

Dehaene, S. (2020). *How We Learn: The New Science of Education and the Brain*. Penguin UK.

Flammer, C. (2015). Does corporate social responsibility lead to superior financial performance? A regression discontinuity approach. *Management Science*, *61*(11), 2549–2568.

Flammer, C. (2021). Corporate green bonds. *Journal of Financial Economics*.

Hickman, E., & Petrin, M. (2021). Trustworthy AI and Corporate Governance: The EU's ethics guidelines for trustworthy artificial intelligence from a company law perspective. *European Business Organization Law Review*, *22*(4), 593–625.

Ito, T. (2020). *Network Structure in ESG Ratings Suggests New Corporate Strategies: Evolving AI Technology to Quantify Qualitative Data.*

Krappel, T., Bogun, A., & Borth, D. (2021). Heterogeneous Ensemble for ESG Ratings Prediction. *ArXiv:2109.10085 [Cs]*. http://arxiv.org/abs/2109.10085

Lee, J., & Underwood, P. (2021). AI in the boardroom: Let the law be in the driving seat. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3874588

Lee, Y.-J., & Zhang, X. T. (2019). AI-Generated Corporate Environmental Data: An Event Study with Predictive Power. In J. Jay Choi & B. Ozkan (Eds.), *Disruptive Innovation in Business and Finance in the Digital World* (Vol. 20, pp. 65–83). Emerald Publishing Limited. https://doi.org/10.1108/S1569-376720190000020009

Marcus, G., & Davis, E. (2019). *Rebooting AI: Building Artificial Intelligence We Can Trust*. Knopf Doubleday Publishing Group.

McBride, R. (2019). Human-Like Implemented AI and Human Problem-Solving A.I. *International Journal of Business, Humanities and Technology*, *9*(3). https://doi.org/10.30845/ijbht.v9n3p1

Peterson, R. L. (2016). *Trading on Sentiment: The Power of Minds Over Markets*. John Wiley & Sons.

Scopino, G. (2015). Do automated trading systems dream of manipulating the price of futures contracts-policing markets for improper trading practices by algorithmic robots. *Fla. L. Rev.*, *67*, 221.

Selim, O. (2020). ESG and AI: The beauty and the beast of sustainable investing. In *Sustainable Investing Sustainable Investing A Path to a New Horizon*. Routledge.

Shahrokhi, M., Parhizgari, A. M., Hashemijoo, M., Okafor, C. E., Nishikawa, Y., & Dastan, A. (2022). Corporate governance and stakeholder capitalism. *Managerial Finance*, *ahead-of-print*(ahead-of-print). https://doi.org/10.1108/MF-01-2022-0056

Stout, L. A. (2012). *The Shareholder Value Myth: How Putting Shareholders First Harms Investors, Corporations, and the Public*. Berrett-Koehler Publishers.

Strubell, E., Ganesh, A., & McCallum, A. (2019). Energy and policy considerations for deep learning in NLP. *ArXiv Preprint ArXiv:1906.02243*.

United Nations (2017) Resolution adopted by the General Assembly on 6 July 2017. (2017). *Work of the Statistical Commission pertaining to the 2030 Agenda for Sustainable Development*.

Wile, R. (n.d.). *A Venture Capital Firm Just Named An Algorithm To Its Board Of Directors—Here's What It Actually Does*. Business Insider. Retrieved March 14, 2022, from https://www.businessinsider.com/vital-named-to-board-2014-5

Zhang, F. (2010). High-frequency trading, stock volatility, and price discovery. *Available at SSRN 1691679*

CHAPTER 4

Ulcer Index-N and Ulcer Performance Index-N

*Russ McBride**
russ.mcbride@ucmerced.edu
and
Alireza Dastan
adastan@ucmerced.edu

Department of the Management of Complex Systems
University of California, Merced
5200 N. Lake Rd., Merced, CA 95343

Abstract

There is growing awareness that the most commonly used risk-reward metrics, like the Sharpe Ratio, are flawed. Including the winning returns as part of the risk and assuming that returns are normally distributed are two of the biggest flaws. These problems, and others, have motivated the search for alternatives. We look at one prominent alternative risk metric, the Ulcer Index, and its risk-return variant, the Ulcer Performance Index. One criticism against it is that it fails to adequately reflect the appropriate risk of the most severe drawdowns. A suggested correction establishes hard boundary for drawdowns beyond which they are weighted more severely. By contrast we suggest that, even if appropriate, there is a graceful solution to this issue, one that simply raises the power of the drawdowns to smoothly reflect greater severity of them as they increase in size. We call the solution the Ulcer Index-N and Ulcer Performance Index-N, respectively, to reflect the Nth power chosen.

Keywords: Ulcer Index-N; Ulcer Performance Index-N; Ulcer index, Ulcer Performance Index, Portfolio analysis; Investment return

Introduction

The search for the preeminent metric to measure and compare investments has been ongoing since before Markowitz's (1952) seminal work that established the basic approaches still in use today. Using the return value as the 'reward' performance measure was quickly noted to be unsatisfactory since there are many paths to the same return number, some fraught with more risk than others. So, the search for the preeminent performance metric was soon narrowed to a search for the best metric for *risk-reward* of an investment.

Though it's true that there are disagreements about whether the 'reward' side as the return should be measured as a real number return, percentage, annualized, or compounded return, there is at least consensus that the reward is some variant of the return. The history of risk has proven more controversial.

The seminal error was made almost immediately, taking 'risk' to be synonymous with volatility. This is a conceptual error that conflates risk with a lack of knowledge specificity. Compare the following two cases. Case A: you have a consistent *loss* of between 2x and 2.1x over the next decade. Case B: you have unpredictable *wins* of between 2x and 2,000,000,000x over the next decade. (A) is risky; (B) reflects a lack of knowledge specificity. Yet, if risk is understood as volatility then we are forced to say that case (B) is far more risky than case (A) since it is far more volatile. But few would suggest that case (B) is risky since you always win; it simply lacks the specificity of case (A). Of course, if the outcome is unspecific and a lack of specificity extends over losses as well as gains then it overlaps with risk. Because volatility typically occurs over both gains and losses, this conceptual conflation between risk and lack of knowledge specificity went unnoticed initially.

The Five Problems

There are at least five problems with most standard metrics of investment performance measures of which this is the first. The four others are: assuming normal distribution; price vs equity movement; inclusion of positive movement for risk measures; and autocorrelation.

Assuming that price movements, and therefore returns based upon price movements of a financial instrument are normally distributed is no longer seen as a strange claim since decades of detailed price data has shown steeper peaks and fatter tails than normal Gaussian distributions would allow. Price movements that should occur once in a billion years have occurred repeatedly as Mandelbrot, Taleb, and allies have been keen to point out (Mandelbrot & Taleb, 2005; Madelbrot & Hudson, 2007; Taleb, 2018; Sueppel, 2018). Price movements and returns often follow more of a Mandelbrot (Levy) curve with a steeper peak and fatter tails. This means that rare events often occur with a much higher probability than a standard Gaussian distribution would suggest.

Fund managers at investment banks and hedge funds will sometimes ignore whether an analysis is performed on price movement or equity curves since they often have longer-term investments where the equity curve is determined by the price movement of a financial instrument. But for active and systematic traders the distinction is important. The equity curve is not determined by the price movement of a single financial instrument, or even multiple equity curves in a portfolio, but by the results of perhaps thousands of historical trade results of a single strategy that might span multiple instruments. A strategy's equity curve is the source material for any statistical analysis of a systematic trader. For the fund manager, a financial instrument's price movement is typically the source for the statistical analysis. This does not necessarily become a problem until one assumes that all the tools of price movement should be handled with the very same tools appropriate for equity curves.

As noted, the classic work on risk assumed it to be synonymous with volatility and volatility was calculated with variance and standard deviation. Variance was calculated as deviation from the mean to both the upside and downside, typically on price movement. Here we see all the aforementioned errors converging, including a new one—incorporating positive returns into the risk measure. Of course, risk is not upside volatility; it is downside events and especially the possibility of extreme downside moves. The most popular performance measure, the Sharpe Ratio, makes the error of assuming that risk equals volatility, uses standard deviation which presumes a normal distribution, is often applied to both price and equity movement, and worst of all includes upside activity alongside downside activity as part of the risk measure in the denominator:

$$\frac{return - RiskFreeRate}{\sqrt{\frac{1}{N}\sum_{i=1}^{N}(x_i - \overline{x})^2}}$$

Figure 1. The Sharpe Ratio

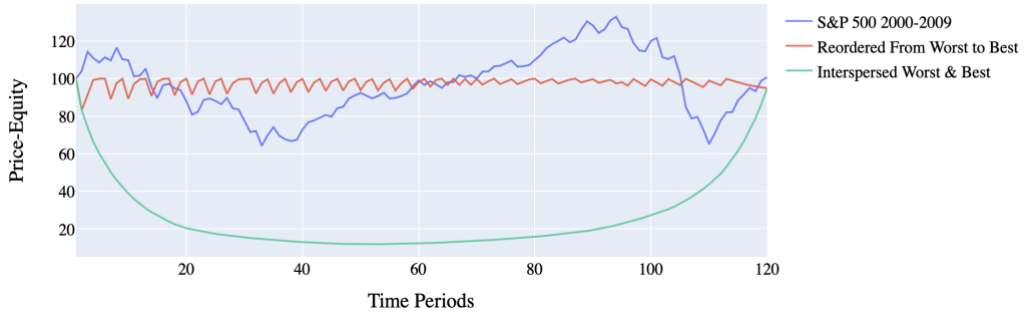

Figure 2. Actual S&P 500 results reordered in two ways have the same statistical performance measures but are clearly in different risk categories

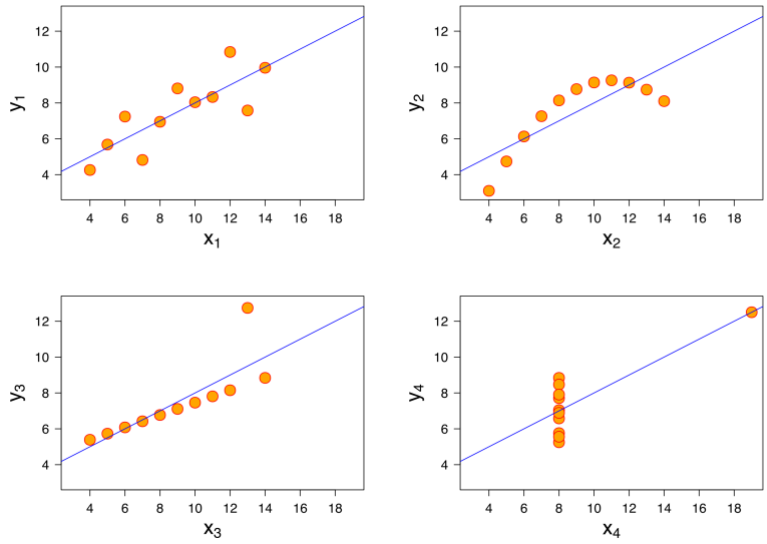

Figure 3. Anscombe's Quartet. Similar to Figure 2, all four data sets have identical statistical measures yet are clearly different. https://commons.wikimedia.org/w/index.php?curid=9838454

The final error that many performance measures succumb to is autocorrelation, i.e., lacking sensitivity to the sequence of the price/equity movements. The three strategies below in Figure 2 are not distinguished by most common measures and yet they are seen as having very different risk profiles. Return, standard deviation of volatility, downside volatility, Sharpe Ratio, Value at Risk (VaR), and Conditional Value at Risk (CVaR), are all the same between the three strategies. Seeing only their numbers without the visualization one would be tempted to consider all three strategies as equivalent. This is another indication that these metrics are not properly capturing 'risk'.This can also be seen as the investment version of "Anscombe's Quartet" (Anscombe, 1972; Chatterjee & Aykut, 2007), the failure of standard statistical measures (in this case—mean, variance on both the x and y axis, correlation, linear regression, and coefficient of the determination of the linear regression) to discern the relevant differences between the graphs—Figure 3.

The Ulcer Index

There is one risk measure that handles all five errors fairly adroitly, the Ulcer Index(UI), developed by Martin (1989). Its risk-return performance metric, the Ulcer Performance Index (UPI), is simply the return divided by the UI. The core of the UI is the drawdown expressed as a percentage and then squared: $(\frac{i}{max_i} - 1) * 100)^2$. The UI can be used over price movements or equity curves, so 'max' is the historical maximum equity or historical maximum price. UI iterates over every time period, either increasing the most recent historical max value or squaring the drawdown value. A value of the current price or equity, i, equal to the most recent max renders $\frac{i}{max_i} - 1$ zero, effectively not contributing to the overall risk measure. The overall risk measure is sensitive to the 'depth' and 'width' of any drawdown period before the value returns back to the max. Increasing drawdowns get N^2 increasing weights—Figure 5.

$$\frac{return}{\sqrt{\frac{1}{N}\sum_{i=1}^{N}((\frac{i}{max_i} - 1) * 100)^2}}$$

Figure 4. The Ulcer Performance Index

All values are summed, including zeros for the same or new max values and then the square root of the summation is taken, so the resulting difference in weighting between two drawdowns is not quite as severe, but a 10x increase in drawdown size (from, e.g., 5% to a 50% drawdown) still has a 100x weight difference, instead of 10x.

The 'Problem' with the Ulcer Index

Despite avoiding the five problems described above and providing increasingly weighted drawdowns to reflect increased risk concern, UI has been criticized for not providing *enough* weight to the most severe drawdowns. Viéville, Gelbrubin, Lindet, and Chevalier (2017) suggest that severe drawdowns should be, not just overweighted, but super overweighted, and they use a graph like this one as evidence of the problem:

The blue strategy has 27 drawdowns of 10% each. The orange strategy has a single drawdown of 40%[1]. They have, however, the same UI value of 7.0. On their view this illustrates the Achilles Heal of UI since the orange strategy with the large single drawdown should get a risk value which significantly exceeds that of the blue strategy.

[1] There are some unknowns in the Viéville et al. (2017) graph which appears to have 27 drawdowns of 10%, but in order to achieve the same UI number of 7.0 with a single 40% drawdown, which equals 1600 when squared, this requires 16 drawdowns, since a 10% drawdown squared equals 100 multiplied 16 times equals 1600. No matter, the fewer the number of 10% drawdowns the more it strengthens the force of their argument—namely, that the UI doesn't rate the risk of the 40% drawdown severly enough. Only needing 16 10% drawdowns instead of 27 to equal the single 40% drawdown illustrates their point more forcefully.

%drawdown	power of 2
5	25
10	100
15	225
20	400
25	625
30	900
35	1.225
40	1.600
45	2.025
50	2500
55	3.025
60	3.600
65	4.225
70	4.900

Figure 5. Power of 2 drawdown multiplier inside the UI calculation.

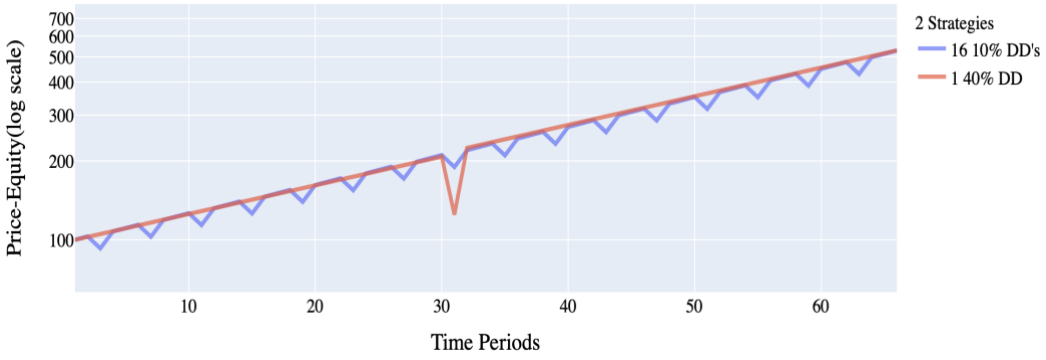

Figure 6. An illustration of the problem with U.I. from Viéville et al. (2017), p14. They see the orange strategy with one large drawdown as deserving of a much worse performance measure while UI gives each an identical result of 7.0.

It's not clear that most will share this intuition, but that is part of their point—that risk tolerance varies from fund to fund, or person to person. There should be some way to accommodate those who feel strongly that the yellow strategy is riskier. Taking their point in the other, unanticipated, direction, it's possible that there are those that feel that the *blue*

strategy is indeed riskier and should accordingly be weighted more heavily as the riskier strategy.

Their concern is not a new one and goes back to the VaR (value at risk) metric. In 1994, J. P. Morgan introduced VaR, a risk measure tool, which has become an accepted standard in the financial industry since. When using VaR, we ask the question "How bad can things get?" or, more formally, "What loss level has X% probability of no being exceeded in N business days?". VaR attempts to provide a simple figure of the downside risk of individual assets and portfolios of assets. VaR is a valuable tool for risk managers and regulators to base their capital requirements due to its conceptual simplicity. Under Basel II, VaR represents the preferred method to calculate capital requirements for credit risk and operational risk. However, VaR also suffers from specific weaknesses. Artzner et al. (1997, 1999), for example, states the following two shortcomings of VaR: First, VaR measures only the percentiles of profit-loss distribution and does not consider any loss beyond the VaR confidence level. This "tail-risk" and can lead to overly optimistic assessments of risks facing a company, i.e., VaR might underestimate the likelihood of large shocks in the markets. Second, VaR is not sub-additive and hence not coherent.

Various alternative risk measures have been proposed to overcome the drawbacks of VaR. The most common alternative is the Expected Shortfall (ES), also known as conditional VaR (CVaR) or expected tail loss. In 1999, Artzner et al. proved that CVaR is sub-additive and hence proves it as a coherent risk measure.

CVaR is the expected loss given the loss is greater than the VaR level and therefore asks, "If things do get bad, what is the expected loss?" (Hull, 2012). I.e., CVaR is the average of the alpha quartile of the highest historical losses of the loss distribution. CVaR is aware of the tail distribution shape while VaR is not (Danielsson, 2005). VaR's major flaw has motivated the Basel Committee on Banking Supervisions (BCBS) to shift from VaR to CVaR for determining regulatory capital requirements (REF).

One Proposed Solution

The proposed solution to the problem of UI not weighting drawdown risk heavily enough is to utilize the drawdown equivalents to VaR and CVaR—DaR and CDaR measures (drawdown at risk and conditional drawdown at risk), advanced by Chekhlov, Uryasev, and Zabarankin (2005). DaR and CDaR demonstrate their value in case of optimized short-term portfolios or when there is leverage in action. Since DaR and CDaR take the worst moments of a portfolio into account, they would project a more conservative approach in risk management than VaR and CvaR (Krokhmal et al. 2003). Viéville et al. suggest incorporating DaR and CDaR with UI into a new risk-return measure. The DaR value establishes a user-chosen drawdown boundary beyond which the drawdown values are super overweighted. Putting this all together, we get what they call the “Serenity Ratio”:

$$\frac{return}{UI * \frac{CDaR}{volatility}}$$

Figure 7. The “Serenity Ratio” from Viéville et al. (2017)

CDaR requires the DaR value as an input to determine which end-range of drawdowns should be super overweighted.

One possible response is that the maximum drawdown (MaxDD) value could instead be used as an absolute filter to exclude strategies that exceed a certain value boundary, but a fund manager might not want to always exclude a strategy beyond a certain MaxDD value and

might want to be able to compare strategies even if they have extreme values. However, portfolio management solely based on MaxDD seems too strict as it might project a one-time irregular event, which may not happen again. The average drawdown (AveDD) could be another solution as well, but this "washes out" the exact difference illustrated by Figure 6 between results with several smaller drawdowns equivalent to results with a single large drawdown. Another possible response is that the UI alone is 'good enough', but this doesn't address individual risk tolerance preferences. Someone with a conservative risk tolerance might need a super overweighting of extreme drawdowns. On the other hand, someone with more appetite for risk might actually prefer an *underweighting* of extreme drawdowns relative to standard UI.

One problem with the proposed solution by Cheklov et al. is the abrupt boundary required in the form of the DaR number that determines the point that separates the normal squared weighting of the UI from the super overweighted extreme drawdowns. It's difficult to imagine that this could properly reflect any individual's psychology such that a 39.999% drawdown feels like it should be weighted normally but a 40.000% drawdown suddenly feels incredibly underweighted.

Ulcer Index-N

We suggest a simple, alternative solution that does not require the inclusion of additional metrics, does not suffer from any abrupt weighting boundary, and offers a graceful way of allowing for personalized risk tolerances. Humans cognitively gravitate toward certain number 'anchors' (Lakoff & Núñez, 2000), like multiples of 10 and the power of 2, but there is no reason to be restrained by the UI's power of 2 applied to the drawdown percentages simply because of a human cognitive inclination. One can instead easily calibrate to different risk values in the two strategies above by increasing the UI exponent.

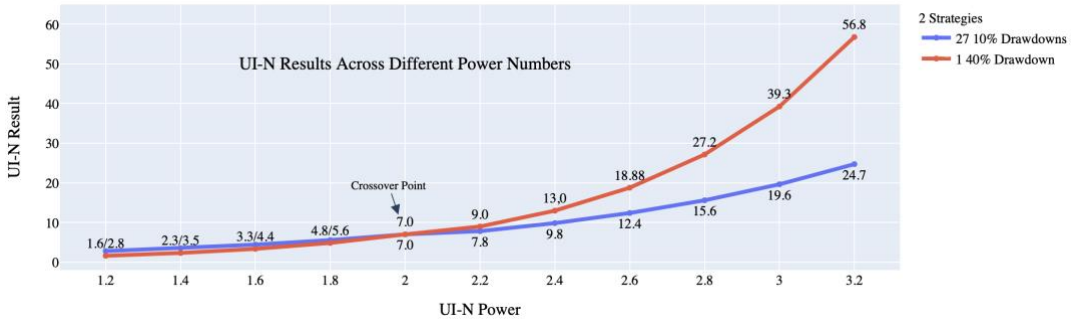

Figure 8. How the UI number changes with a change in the power level

If you see the two strategies as of similar risk, then use the standard UI power of 2.0. If the yellow strategy seems slightly riskier to you, choose a higher power. This will of course increase the UI for the blue strategy as well but at a slower rate. Figure 8 and Figure 9 show the different UI numbers at different power levels. (Note that the final step of calculating the UI, taking the square root, does not change on our suggested solution, regardless of the power level chosen.) A power level of 2.0 gives an equivalent UI for the two strategies. 3.0 offers risk values for the yellow strategy that is roughly double—19.6 vs. 39.3.

Power	^1.2	^1.4	^1.6	^1.8	^2.0	^2.2	^2.4	^2.6	^2.8	^3.0	^3.2
UI-N Results for Blue (16 DDs of 10%)	2.8	3.5	4.4	5.6	7.0	7.8	9.8	12.4	15.6	19.6	24.7
UI-N Results for Orange (1 DD of 40%)	1.6	2.3	3.3	4.8	7.0	9.0	13.0	18.8	27.1	39.2	56.8
% Change	-75%	-52%	-33%	-17%	0%	15%	33%	52%	74%	100%	130%

Figure 9. Difference between the blue & orange strategy's UI-N results for different chosen N power levels

If the blue strategy seems 15% more risky choose 2.2. If it seems twice as risky choose 3.0. Of course, if, for some reason, the yellow strategy feels *less* risky, you could even move in the other direction toward 1.8 or 1.6 for the power number.

Rendering the UI drawdown exponent as a variable gives us a new risk measure, we refer to as UI-N and UPI-N to reflect the Nth power of the exponent. A range of 2.0 to 3.0 should be appropriate for almost all individuals in most circumstances, but obviously other choices are possible.

Beyond avoiding the five initial problems, the UI is somewhat time insensitive, allowing different strategy time durations to be compared. UI-N is no different, but it does have a downside strategies compared with differing N values will, of course not be readily comparable to each other. Each UI-N, of differing Ns will essentially be a different performance metric. This is to be expected. This is the flip side of affording a more flexible metric. Those who prefer a standard basis of comparison can retain the N of 2 in the regular UI. UI-N does allow fund managers to standardize on some N appropriate to their context and then compare strategies on that UI-N.

We suspect that in the future, a consensus could emerge around an N, and many will opt for an N of 2.2 or 2.4, effectively establishing a standard UI-N. UI-N, in any case, should be reported along with the power level chosen—e.g., UI-N=2.8. Reporting standard UI as UI-N=2.0 will help retain clarity. One option is to establish an N at each firm to set a context of assessment for all funds in their pool as a standard context of comparison while still asserting a specific level or risk tolerance. This would go a long way toward addressing the concern that extreme drawdowns need further weighting without adding ad-hoc calculations or multiple options.

UI-N is by no means the ultimate risk-reward metric that has long been sought. One might wish for a better way of comparing similar drawdowns and returns over different time periods. We suggest, though, that the risk measure of UI-N (and the performance risk-reward measure, UPI-N) afford a flexible and graceful solution that improves upon UI and avoids the five major problems above that plague the most popular risk-reward metrics. To repurpose Churchill's quote about democracy, one might go so far as to consider UI-N the worst form of the simple risk-reward metrics… except for all the others. It does at least offer an advance upon UI and step forward in the ongoing quest to find a better investment performance metric.

References

Anscombe, F. 1973. Graphs in Statistical Analysis. *The American Statistician, 27*(1), 17-21. doi:10.2307/2682899.

Artzner, P., Delbaen, F., Eber, J.M. and Heath, D., 1999. Coherent measures of risk. Mathematical finance, 9(3), pp.203-228.

Chatterjee, S., & Firat, A. 2007. Generating Data with Identical Statistics but Dissimilar Graphics: A Follow up to the Anscombe Dataset. *The American Statistician, 61*(3), 248-254. Retrieved April 16, 2021, from http://www.jstor.org/stable/27643902

Chekhlov A., Uryasev S. and Zabarankin M. (2005). Drawdown measure in portfolio optimization. *International Journal of Theoretical and Applied Finance*, 8(1), 13 58.

Danielsson, J., Jorgensen, B.N., Mandira, S., Samorodnitsky, G. and De Vries, C.G., 2005. Subadditivity re-examined: the case for Value-at-Risk. Cornell University Operations Research and Industrial Engineering.

Hull, J., 2012. Risk management and financial institutions,+ Web Site (Vol. 733). John Wiley & Sons.

Krokhmal, P., Uryasev, S., & Zrazhevsky. G. (2003). *Numercial comparison of CVar and CDar approaches: Application to hedge funds.* The Stochastic Programming Approach to asset-Liability and Wealth Management. AIMR.

Lakoff, G. and Núñez, R., 2000. *Where Mathematics Comes From*. New York: Basic Books.

Mandelbrot, B. and Hudson, R.L., 2007. *The Misbehavior of Markets: A fractal view of financial turbulence*. Basic books.

Mandelbrot, B. and Taleb, N.N., 2005. How the finance gurus get risk all wrong. *Fortune Magazine, July, 11*.

Markowitz, H. M. 1952. "Portfolio Selection." *Journal of Finance. V*ol. 7, no. 1. March:77–91.

Martin, P. 1989. *The Investor's Guide to Fidelity Funds*. Wiley.

Sueppel, R. 2018. The Dangerous Disregard for Fat Tails in Quantitative Finance. *Systematic Risk & Systematic Value*. July 18, 2018. https://www.sr-sv.com/the-dangerous-disregard-of-fat-tails-in-quantitative-finance/

Taleb, N.N., 2018. Real-world Statistical Consequences of Fat Tails: Papers and Commentary.

Viéville, R.B. de, Gelrubin, R., Lindet, E., Chevalier, C. 2017. An Alternative Portfolio Theory. Key Quant White Paper. https://www.keyquant.com/Download/GetFile?Filename=%5CPublications%5CKeyQuant_WhitePaper_APT_Part1.pdf.

CHAPTER 5

CONCLUSION

Through transparency enhanced by AI, there is a chance to close the divide between companies and their stakeholders in risk management, sustainable investment, and compliance with the regulation. The above figures and studies depict the combined efforts of these elements to ensure the enhancement of ESG practices while simultaneously providing a common platform for sustainable development. Building on these findings, it is possible to further elaborate on how transparency is essential in forming trust and people's willingness to participate in collective action toward a more sustainable future.

One of transparency's most significant contributions is its role in enhancing risk assessment, a critical factor for sustainable investment. Complex AI and NLP techniques can process vast amounts of structured and unstructured data to realize risks related to environmental degradation, social unrest, or governance failures. For example, machine learning algorithms can detect patterns that signal potential regulatory non-compliance or supply chain vulnerabilities. This approach enables companies to address risks long before they turn into financial or brand-damaging issues.

Transparency in risk assessment benefits investors by providing them with clear and detailed analyses of a company's ESG-related risks and opportunities. For corporations, transparency in risk assessment fosters a culture of accountability and resilience. Transparency is the most significant lubricator of sustainable investment. Without it investors have no access to reliable and comparable benchmarks and data. It is the cornerstone of ability to evaluate the true ESG performance of companies. Advanced AI can standardize and simplify this data, reducing complexity and enhancing accessibility. For instance, natural language processing (NLP) can be used to analyze corporate sustainability reports and break down the data into meaningful metrics that are then translated into valuable data.

Furthermore, it helps prevent greenwashing, a despicable act whereby organizations amplify or make environmentally friendly assertions. AI tools can fact-check companies' claims by using external data such as satellite images or third-party assessments. Therefore, by identifying the gaps, these tools ensure that companies remain honest and that investors do not make decisions based on misinformation.

Sustainable investment also benefits from AI-driven scenario analysis, which evaluates the potential outcomes of various sustainability strategies. For example, AI can simulate the financial consequences of the shift to using renewable energy or the circular economy. Such simulations help investors comprehend the potential returns as well as the risks that come with various strategies, hence fostering sensible and sustainable investment choices . Investment flow and market growth itself would be in a sustainable manner when the performance reporting is straightforward and comprehensive, and thus, the regulations are adhered to, and the legal and financial consequences are avoided.

AI could allow meeting these regulations by providing data collection, analysis, and reporting solutions. For instance, AI algorithms can track a company's processes in the course of its business and provide compliance reports on possible violations in real time. These solutions help decrease the costs and complexities involved in compliance while ensuring that the information provided is correct and up to date.

Transparency also helps establish a good working relationship between corporations and regulators. Through proper disclosure of information, companies can show their compliance with set regulations, thus creating a sound image between the two parties. This collaboration can result in enhanced and adaptable regulations that are favorable for the growth of new firms and environmentally and socially friendly governance regimes.

For stakeholders, regulatory and compliance transparency ensures that corporations are held accountable for their ESG commitments. It gives consumers, employees, and the general public a voice to demand better practices and ensure that businesses are held to account for their actions. This collective accountability ensures that ESG practices improve for society's benefit.

The role of transparency is to form a link between corporations and their stakeholders and create a common vision and perception for ESG objectives and issues. It provides investors with the clarity needed to align financial strategies with sustainability objectives. For customers, it offers assurance that the products and services they consume are ethically and sustainably produced. For employees, it reinforces the alignment of their work with their values and, therefore, increases motivation and output. It is advantageous to communities and regulators since it allows the latter to track the former's actions and ask for enhancements if needed. For instance, it is possible to present the social and environmental consequences of corporate actions with the help of artificial intelligence, which facilitates stakeholders to engage with businesses effectively. This not only solves conflicts but also finds ways and opportunities for collaborative initiatives that are beneficial for all the parties involved.

Therefore, transparency links these stakeholders and makes them work together for a sustainable future. It changes the dynamic of the corporate-stakeholder interaction from one based on mistrust to one based on trust and collaboration. This is crucial for solving the issues that affect the whole world, including climate change, social injustice, and the shortage of resources.

Also, ethical AI cannot be achieved without proper governance that will set guidelines on how data and algorithms should be used and with what level of transparency. These frameworks must be created in a manner that involves corporations, regulators, and civil society. In this way, the possible drawbacks of AI can be minimized so that the technology's advantages can be harnessed in an equitable and non-biased way.

Through the enhancement of risk management, support of sustainable investment, and enforcement of regulatory compliance, transparency creates trust and promotes collective efforts towards sustainability. It creates opportunities for partnerships, increases efficiency, and promotes creativity, thus providing a strong platform for the success of ESG markets. However, to make these benefits a reality, some ethical AI considerations on fairness, inclusion, and accountability have to be considered. Therefore, when considering these factors, corporations and stakeholders will be able to take advantage of the element of transparency to promote sustainable entrepreneurship and corporate social responsibility and pave the way for a sustainable and more just society.

On the other hand, institutional and retail investors would be more encouraged to flow the money toward ESG asset class and not only out of sentiment but through sustainable market growth. Therefore, transparency supported by sophisticated and ever-evolving AI is a powerful bipartisan tool that can be used to end the divide between the polar opposite parties and culture wars in regards to ESG asset class and asset allocation.