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# Corporate governance and climate change risks. A game-theoretic approach.

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# Dedication

To my family and my beloved sister, Maria-Kyriaki.

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I would like to thank my dear professor, mr. Dimitrios Voliotis for his support and share of knowledge during my master's thesis. Also, I would like to thank all the professors for sharing their knowledge and assistant.

# Abstract

The world needs to acknowledge climate change as a threat and take the necessary steps to reduce its consequences, or else humankind will confront a wide range of problems from many different angles. The governments, in particular, have already acknowledged how crucial it is for the financial system to finally become sustainable and how shifting to a low-carbon, environmentally friendly economy may facilitate this transformation. In fact, it is of a paramount importance that the financial system in the future be in line with the Sustainable Development Goals. The objective of this master's thesis is to determine the corporate governance and climate change risks. The emphasis on the financial system and international cooperation in establishing the sustainability of the global economy is still another objective of this thesis. This thesis has examined numerous studies about the corporate governance of companies around the globe in conjunction with the climate change circumstances. The biggest question is based on the board members' decisions in the future that may influence not only financial stability but also affect people prosperity.



**Keywords: Corporate governance, climate change, game-theory, institutional investors**

**Περίληψη**

Η κλιματική αλλαγή αποτελεί μια απειλή για την ανθρωπότητα και είναι απαραίτητο να παρθούν μέτρα με άμεσο σκοπό την μείωση των συνεπειών αυτού του φαινομένου, καθώς σε διαφορετική περίπτωση η ανθρωπότητα πρόκειται να αντιμετωπίσει ένα ευρύ φάσμα προβλημάτων. Οι κυβερνήσεις έχουν ήδη αναγνωρίσει τη κρισιμότητα της σταθερότητας του χρηματοπιστωτικού συστήματος και ειδικότερα η περιβαλλοντική στροφή της οικονομίας μπορεί να διασφαλίσει αυτή τη σταθερότητα στο μέλλον. Ο στόχος της διατριβής είναι η ανάλυση της εταιρικής διακυβέρνησης και των κινδύνων που συνεπάγονται λόγω της κλιματικής αλλαγής. Επίσης, δίνεται έμφαση στο χρηματοπιστωτικό σύστημα και στη διεθνή συνεργασία για την καθιέρωση της βιωσιμότητας της παγκόσμιας οικονομίας μέσω διαφορετικών ερευνητικών άρθρων που μελετούν την εταιρική διακυβέρνηση των εταιρειών σε όλο τον κόσμο σε συνδυασμό με τις συνθήκες αλλαγής του κλίματος. Τέλος, το βασικό ερώτημα του μέλλοντος πρόκειται να αφορά τις αποφάσεις των μελών του διοικητικού συμβουλίου ως προς την κλιματική αλλαγή που πρόκειται να επηρεάσουν όχι μόνο τη χρηματοπιστωτική σταθερότητα αλλά και την ευημερία των ανθρώπων.

**Λέξεις Κλειδιά: Εταιρική Διακυβέρνηση, κλιματική αλλαγή, θεωρία παιγνίων, θεσμικοί επενδυτές**

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# Introduction

Climate change is no longer seen an inconvenient “externality” to be considered by business firms or a phenomenon that has little basis in scientific fact (Dietz & Hope, 2007). Specifically, the Stern Report (Dietz & Hope, 2007) and the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) both state that scientific data shows that the global climate is rapidly changing in response to the rising atmospheric concentrations of greenhouse gases (GHG) from human economic activity.

The increase in global temperature brought on by the greenhouse effect is linked with climate change. Climate change is regarded to be a major factor in the global occurrence of non-linear and extreme natural events. For instance, warmer land and air changes in rainfall patterns, rising sea levels, melting sea ice and glaciers, and protracted droughts, damage to marine ecosystem that result in shortages of food and water, are a few of the phenomena (Lujala et al., 2015). According to estimates made with a high accuracy, an increase in Greenhouse Gas concentrations will influence the severity and frequency of climate change events (Manabe, 2019).

A study by Deloitte (2009) found that the market demands for eco-friendly goods and technologies have led to the emergence of new legislation, reporting and transparency requirements, increased investor pressure, and volatility in energy prices. In brief, Llewellyn (2007) found in a previous study that a company's ability to effectively address climate change is evolving into a competitive advantage, while the long-term viability of organizations that do not effectively address the issue is in doubt.

Investors are beginning to assess companies based on their amount of preparedness for climate change, claims Hoffman(2007).Reputational risk, competition risk, physical danger, and regulatory risk are a few examples of potential risks from climate change. The many categories of climate change risk and their effects on businesses and national competitiveness are discussed in more detail in the sections that follow.

Kolk & Pinkse (2005) asser tthat in order to effectively lead their organizations, business leaders must take into account both the legal and physical hazards of climate change and their potential. Galbreath (2010) and Hoffman (2007)who observed that corporate governance for climate change is crucial to the oversight and strategic direction of firms, support this point of view. However, little is known about how governance methods are handling the climate change issue in businesses worldwide, claims Galbreath (2010).

A corporation may be at risk from climate change. The board must show that it has fully addressed the challenges of climate change risk management. According to Smith et al. (2008) and the terms of the King code, the CEO and the Board may be held accountable for any avoidable losses of shareholder value. According to Ceres (Dawkins & Fraas, 2011), shareholder and consumer activism as well as climate change litigation are on the rise. In these conditions, climate change is increasingly emerging as a strategic business concern.

Investors and financial analysts are increasingly placing value on businesses that foresee and seize the business opportunities that are presented by climate change, whether as a result of greenhouse gas regulations, immediate physical effects, or modifications to their reputation, according to Cogan (2006).

The main goal of this dissertation is to emphasize the importance of the financial system and international collaboration in determining the viability of the global economy. This dissertationincludes a wide range of studies on corporate governance of businesses, globally, in light of the climate change situation. The main question is on the board members' potential future actions, which might damage, not just the economy, but also the prosperity of the general public.

# Chapter 1:

# The Multidimensional Challenges of Climate Change

## 1.1 Challenges and objectives related to climate change

The biggest and most complicated sustainability challenge currently endangering the ability of our planet to support human life is climate change (Guterres, 2019). If carbon emissions continue at their current rate, the Intergovernmental Panel on Climate Change projects that between 2030 and 2052, the average increase in global temperature from the current 1°C, over pre-industrial levels to 1.5°C will occur (IPCC, 2014).

The projected long-term effects are dire, including increased chances of droughts and flooding, a considerable rise in sea level, and the extinction of many species. As a result, there is an urgency to stop climate disruption and reverse its effects. There is no Planet B, as former UN Secretary-General Ban Ki-Moon (United Nations, 2016) emphasizes, thus there is no Plan B.

Globally, the importance of climate change mitigation has grown quickly on policymakers' priorities (Guterres, 2019). The Paris Agreement, in particular, served as a wake-up call for a number of nations regarding the externalities of the existing high-carbon economy (UNFCCC, 2015). Global leaders came together and decided to reduce the increase in the average global temperature to no more than 2°C over pre-industrial levels, ideally 1.5°C.

A global commitment to reducing climate change was demonstrated by the Paris Agreement, which 187 out of 197 nations have signed since the convention. Climate change may have a detrimental effect on the stability of the financial system and the value of investments (Vener et al., 2019). Both in terms of short-term earnings and long-term value development, equity investors are concerned about numerous and pervasive effects affecting their investment returns. Physical risk and transition risk are the two main sources of climate-related risks in investor portfolios (Clapp et al., 2017).

Physical risk refers to expenses for physical harm to the site of the funded project and the effectiveness of the adaption strategy (Clapp et al., 2017). Physical danger is divided into acute and chronic types (Griffin et al., 2019). Acute risk comprises extreme weather occurrences that result in physical harm to infrastructure, such as buildings and other structures, and are made worse by climate change. Long-term, permanent changes in climatic patterns, such as an increase in the

frequency of extreme weather, rising sea levels, floods, and wildfires, are represented by chronic risk.

The sector and activity that the project will finance determines the risks associated with it. In keeping with the objectives of the Paris Agreement, it refers to the financial risk connected with the move towards a low-carbon, and eventually decarbonized, economy (Fang et al.,2018). Regulational and technological hazards are other categories of transition risks (Krueger et al., 2020).

Regulatory risk develops from significant policy and regulatory changes or predictions of similar changes, such as carbon levies, fuel-efficiency standards, and emission trading schemes like the ETS2 (Lemphers, 2020). The advancement of developing, investing in, and utilizing emerging technologies to assist the shift to a low-carbon economy is referred to as technological risk.

One of the most significant transition hazards is the possibility of assets becoming stranded (Andersson et al., 2016). This risk relates to an unexpected decline in asset value brought on by a sudden change in technology, rules, social norms, or the environment. It is both a technological and a regulatory risk.

Future advancements in future technology and legislation aimed at reducing emissions may result in a drop in consumer demand for high-carbon goods. As a result, investments that produce stranded assets are unable to generate a sustainable economic return, leaving resources untapped.The combination of new laws, rules, and technologies has the ability to alter market dynamics and affect investment returns (Åhman et al., 2017).

## 1.2 The impact of climate change on corporations

Climate change may eventually have an impact on a company's portfolio returns, but it may also serve, as the basis for a number of economic opportunities. Investors would be able to make better investing decisions, if climate issues were taken into account. They ought to be capable of long-term analysis of all potential hazards and possibilities for businesses. Investors should push businesses to adopt higher standards and better procedures on these matters once they have considered the whole spectrum of factors that affect both risk and return.

They would actively participate in this way to achieving sustainable development and a green economy. Shareholder action could reduce risk and ensure that the portfolio of companies is primarily focused on cost-cutting and cutting-edge climate products. Investors would benefit more from early information when assessing portfolio allocation and its adherence to climate

commitments. Price shifts could be tempered if businesses disclosed more information about their climate-related risks and possibilities.

The crucial key sets that investors take into account are the environmental policies that the issuer has enacted and the board's governance. They think that a number of adjustments are required, and that businesses should additionally explain how explicitly they estimate the risk.

In order to restrict global warming to well below 2 degrees Celsius ($^{o}$C) beyond pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 $^{o}$C above pre-industrial levels, 196 Parties (195 States and the European Union) approved the Paris Agreement in December 2015. The Agreement also acknowledged the urgent and perhaps irreversible threat that climate change poses to human society and the environment, and that this threat will necessitate significant cuts in global greenhouse gas (GHG) 1 emissions.

Additionally, it tries to align financial flows with a path toward low GHG emissions and growth that is climate resilient. For the macroeconomy and the financial system, the expected rise in global temperatures and related climatic changes, such as fluctuations in rainfall or storm characteristics, as well as the Paris Agreement's indicated transition to a low-carbon economy, might have far-reaching effects.

Markets might be, directly or indirectly, impacted by climate change. In specifically, climate-related risk can be divided into three categories: environmental uncertainty, economic climate risk, and climate policy risk. According to Greenpeace, there is a further risk referred to as "business risk," and it should cover all dangers associated with rising capital costs, rising operating costs, the potential for assets to lose value and and reputational harm that could lead to a decline in market valuation.

The use of fossil fuels to fuel economic expansion and the industrialized types of agriculture required to feed a gradually healthier global population are the main factors, that contribute to environmental deterioration. Anthropogenic climate change is the final conclusion that poses a hazard to the environment.

Climate change is now a fact on a worldwide scale; it is already occurring, and society as a whole is already paying the price. It is crucial that firms avoid delaying the issue because of this. This entails a radical transformation of the global economy and, consequently, of investor thought.

While some investments will be at risk, others will profit from it. Investors' perspectives and tolerance for climate change-related risk vary. In order to rationally focus on the pertinent areas of the analysis, investors must take into account a broad perspective of all potential hazards. They should understand the potential hazards, which that affect the economy through various

channels and how this might impact the values of all different kinds of assets. These risks can roughly be separated into direct investor risk and asset level risk.

Consequences that directly affect markets are considered as investors' risk. Investors can no longer disregard the implications of climate change. Additionally, portfolios are constantly becoming riskier, particularly those that are directly related to energy businesses. Investors are directly impacted by some regulatory risks, while financial market regulation pretends to be more transparent and asksorganizations to put into practice climate-related strategies. However, this emphasis on climate change issues has some detrimental economic effects.

Indeed, several studies have shown that environmental concerns can hurt companies, since they often perform poorly financially, which is a sort of investment risk. However, because of stranded assets, portfolio holdings may be excessively valued. Recently, this phrase has grown significantly in significance, especially in light of environmental and climate change issues.

All effects of climate change on the global economy might be considered an asset level risk. The definition placed a special emphasis on physical risk for discrete assets. These newsworthy incidents have also caused changes in the insurance sector, and companies are now dealing with catastrophe insurance.

The risk of rising carbon prices for underlying assets is another category of asset level risk. Investors are now concerned whenever production systems or facilities are exposed to changes in carbon price policy, such as local, national, or global levies, or cap & trade systems. Following climate change-related natural disasters, there may also be another issue because the most climate-impacting businesses frequently end up being responsible for these kinds of damages.

Furthermore, reputational risk is increasingly influencing financial markets and has recently gained importance for investors. When making investments, institutional investors have begun to take sustainability factors into account, so as to improve the risk/return profile of investments.

Moreover, not only they desire to promote sustainable thinking and business attitudes, but also may they want to comply with the national and international accepted standards/norms or specific values determined by their own society within their investment activity.The first justification aims to replicate specific ideals in the investment portfolio, regardless of the financial impact and without actively trying to change corporate processes. Recent research has demonstrated that global standards like the Global Compact or the OECD recommendations for multinational firms have some influence on the opinions of investors.

Because of this, even minor owners must examine their investments to make sure they do not go against the law. 190 Rejecting investments in sectors that are at odds with the organization's principles or just staying away from sectors like the tobacco or military one are alternative ways to improve corporate attitudes.

The second reason was primarily discussed in the paragraph above, while the third one is predicated on the idea that adding sustainability considerations to investment decisions may increase financial awareness over the short, medium, or long term. This justification relates to the notion of the fiduciary obligation, which states that when investors are handling the money of other savers, they should act to ensure that their own interests are wholly protected.

The most significant of these obligations, which closely relate to the duties of institutional investors, are prudence and loyalty. To act in the best interests of the company, directors and officers must take into account the possibility that they are aware of the physical and transitional hazards associated with climate change issues and how these risks may affect their company. The incorporation of ESG variables is thought to be extended by the prudent management assets mechanism.

## 1.3 Motives for making sustainable investments

More ethical and sustainable corporate practices may lead to better investment opportunities in the long run, according to several research. For instance, some businesses believe that their investments might benefit the route to sustainable growth because of ethical considerations. It might be claimed that businesses engaged in these types of investments tend to have evolving incentives.

Prior to integrating ESG aspects into their assessment and investment processes, firms must first be compliant with regulations. By doing this, they lower their risk and open themselves up to new investing possibilities. Finally, a sense of responsibility has permeated the entire organization, and managers feel compelled to make investments that will make the economy more sustainable as a whole.

For one or more of these reasons, investors who manage capital on a fiduciary basis for third parties regularly take sustainability concerns into account when valuing investments and choosing their investment strategy. The data below assists senior management in identifying the pertinent reasons for engaging in sustainable investment.

Learning how to transition the financial system and its intermediaries from the conventional idea of finance to sustainable infrastructure finance is a matter of the utmost importance. Increasing the proper market signals can be an effective method to boost infrastructure finance from private sources. Additionally, investors can view risk differently and comprehend the possible return on their investments if regulators and policy-makers assist in reorienting them by emphasizing the favorable characteristics that defined those types of investments.

Investments in sustainable development will need enough sources of long-term finance, and they must be made by the public sector through increased public incentives as well as the private sector, which genuinely depends on those efforts. It has been revealed in the 2011 World Economic and Social Survey that the green economy approach is likely completely compatible with sustainable development.

Additionally, it has highlighted the necessity of swift action thatwould shift the economy away from the complacency of current financial practices and toward a new idea of finance. In a green policy agenda, policymakers have attempted to balance the goals of the economy and the environment, but there were three key challenges.

# Chapter 2:

# Literature Review

Climate change is not a new topic, it has recently sparked significant interest among government and business leaders, scientists, and general people. According to experts the earth's temperature is rising and also governments around the globe have shown acknowledgment of the issue of climate change and have already begun implementing new policies so as to eliminate. Furthermore, more and more companies are under pressure to become eco-friendly because in this way they will have a competitive advantage (Hoffman, 2007).

Galbreath (2010) study 98 US and non-US industries in 10 countries in order to seek how they are dealing with climate change through five different governance practices. Due to a lack of prior research and the lack of a universally agreed conceptualization, this study drew on data from the Coalition for Environmentally Responsible Economies (Ceres), which defined and evaluated climate change governance practices in 98 enterprises. The companies were mostly based in the United States, with only about 30% of the sample coming from outside the country.

Moreover, a specialized secondary data source was used to analyze and rate governance procedures addressing climate change for a worldwide sample of enterprises in order to better understand how firms approach climate change from a governance viewpoint. Because institutional pressures to address climate change appear to differ by country, using an international sample is critical (Galbreath, 2010).

Comparable data gives depth to the research and aids in understanding the implications of institutional theory. Second, the structure of boards is critical for resolving strategic challenges, formulating policies, and eventually governing businesses. It was an exploratory study. This means thatits focus was on determining whether board structure had an effect on the performance levels of corporations' climate change governance strategies, or not (Galbreath, 2010).

The result of this study is that according to Ceres' score methodology, companies appear to be underperforming in terms of how well their governance procedures address climate change. Non-US enterprises, on the other hand, outperform US firms on all five governance dimensions studied. Institutional factors may be to blame for a greater attention on climate change outside of the United States, confirming prior findings Galbreath, 2010).

Furthermore, when the governance dimensions were split into low and high performing firms, some board structure factors were connected to higher performing firms. Firms with larger boards, distinct CEO–board chair responsibilities, younger directors, and a higher share of inside executives appear to have a framework that leads to better success in climate governance practices. As a result, a few major policy recommendations are made in light of the study's findings Galbreath, 2010).

Cotter & Najah (2012) investigate the influence of institutional investors on a complete set of climate change disclosures (e.g. regulatory, physical and other risks and opportunities of climate change; greenhouse gas (GHG) emissions intensity and energy use) for a global sample of significant corporations using a stakeholder engagement viewpoint.

Then use a complete overview of climate change reports for a global sample of significant corporations, they study the aggregate influence of institutional investors from a stakeholder engagement viewpoint. For corporations in which they own significant shares, institutional investors are a formidable and respectable stakeholder group. Also, they demand to have high-quality information about businesses' exposure to climate-related hazards (Cotter & Najah, 2012).

More specifically, large institutional investors manage portfolios that are commonly highly diversified and long-term, reflecting worldwide capital markets. Their portfolios are inexorably vulnerable to rising and broad costs resulting from corporate environmental degradation. Moreover, they can have a positive impact on how companies are run to reduce externalities and reduce their overall exposure to these expenses (Cotter & Najah, 2012).

Institutional investors should take an action and decrease the financial risk linked to environmental concerns. Thefindings of a highly substantial association across institutional investor engagement and climate change disclosure backs up stakeholder theory and shows how this prominent and respectable stakeholder group can influence business disclosures (Cotter & Najah, 2012).

They quantify business responsiveness to institutional investor expectations regarding climate change disclosure using three metrics of stakeholder influence. When a company agrees to complete the CDP questionnaire and consents to its response being published on the CDP website, this is the first sign of institutional investor influence.Secondly, they search at annual and sustainability reports, as well as business websites, to see if institutional investor objectives have driven corporate climate change disclosures (Cotter & Najah, 2012).

Companies can identify the impact of CDP activities on their disclosures in a number of different ways, from stating that they may have engaged in CDP activities in the annual or sustainability report to posting their whole CDP survey reply on their company website. The third indicator measures how much and how well a corporation provides climate change information in their CDP survey questionnaire (Cotter & Najah, 2012).

The main result of Cotter & Najah's (2012) research is the positive impact on climate change disclosure by stakeholders through corporate communication channels and the study contributes to the research by looking at and supporting the importance of constructive shareholder engagement in climate change disclosures.

Dyck et al.(2019) examine a different approach so as to highlight the value of E&S success to shareholders. We investigate whether there is a link between share ownership and firm E&S performance. It's difficult to refute the idea that E&S investments benefit shareholders if they are a driving force behind companies' E&S decisions.

Due to the fact that pressure for E&S improvement is a really global phenomena, they investigate how shareholders drive E&S performance for enterprises around the world. They look into institutional investors in particular because they own and vote the majority of the world's equity capital. We use items listed (encompassing topics including CO2 emissions, renewable energy usage, human rights violations, and workforce quality) from numerous E&S data providers to create firm-level social and environmental performance measures (Dyck et al., 2019).

They built a sample of 3,277 non-US enterprises from 41 countries from 2004 to 2013 using these indicators of E&S performance, ownership concentration data, and financial data. Moreover, they give new information that institutional investors advocate for stronger firm-level E&S performance all around globe, using a large sample of publicly traded enterprises from more than 40 countries. To comprehend what motivates investors to advocate for higher E&S performance, time series as well as cross-sectional tests were used (Dyck et al., 2019).

By using global financial crisis as the examined period, Dyck et al. (2019) discovered that financial motivations play a tremendous influence. After appreciating the benefits of E&S during the crisis, firms with higher institutional ownership pressed harder for improved E&S performance. They also wondered if a desire to improve firms' E&S performance in order to meet the expectations of persons in the investors' local community would motivate them to advocate for higher E&S performance. Culture and social standards ought to be irrelevant if just financial reasons are important. Instead, they discovered that cultural background is important. Foreign institutional investors based in nations with robust E&S credentials are the ones who have an impact on a company's E&S performance.

This finding implies that a society's social standards flow through the investment portfolio pathway into enterprises, providing new evidence on how culture influences financial decision. Finally,according to the findings from a sample of US companies show that foreign investors from countries with high social norms are already active and effective in pressuring US firms to optimize their E&S performance. These E&S-minded overseas investors own a modest percentage of US companies (Dyck et al., 2019).

In addition, Haque & Deegan (2010) examine climate change-related corporate governance disclosure practices of five main Australian energy-intensive corporations. The companies were

chosen based on the criterion of being in a sector that is anticipated to be severely impacted by climate change and being represented on the Australian Securities Exchange. In this was a data analysis instrument is created to detect disclosures made in regard to different policies and processes in place by the organizations to address climate change challenges. An annual and sustainability reports were used of the individual companies between 1992 and 2007.

Haque & Deegan's (2010) study contributes to the social and environmental accounting literature by providing an overview of large Australian corporations' reporting practices in relation to climate change-related governance practices — an area where there is currently insufficient information. The disclosure policies of major Australian firms in relation to climate change-related governance disclosure practices were investigated using a content analysis research method in this study.

Companies' climate change-related governance disclosures have been classified into a disclosure category. They expected a rising trend in business climate change-related governance practice disclosures during the course of our investigation in this research project. The evidence of this study is that in recent years have seen the biggest number of disclosures in comparison to previous years. Companies' climate change-related governance practice disclosures have generally risen over the examined period, while the companies still give a low level of disclosure.Moreover, reporting on climate change-related practices by large Australian corporations is still at a low level (Haque & Deegan, 2010).

While some topics have been quite effectively disclosed, none of the corporations have made disclosures throughout all, of the issues indicated in our 'best practice' analysis. Furthermore, a few of the companies in the sample gave extremely limited disclosures during the course of our investigation, leading us to doubt their quality (Haque & Deegan, 2010).

Moreover, when a variety of stakeholders, including governments, began to pay attention to the potentially extremely significant effects and the need to take action, one of the environmental challenges that has drawn business attention more and more throughout the course of the 1990s was climate change. Over the years, businesses have created a variety of approaches to combating climate change, initially more political and non-market in nature but today also market-oriented (Haque & Deegan, 2010).

Since 1995, companies' political stances have gradually shifted from opposition to climate measures to a more proactive approach or a "wait and see" attitude. Many of them have also begun to take market actions to be ready to deal with regulation or to go beyond that, considering risks and opportunities. Some businesses reportedly rely on the direction taken by their national governments in the wake of the passage of the Kyoto Protocol and postpone taking action until after climate policy has been put into practice (Haque & Deegan, 2010).

On the other hand, others have made the decision to start emission reduction activities in order to foresee future policy, social, or competitive changes. Due to regional, sectoral, and company-specific considerations, corporate attitudes on climate change vary significantly (Van der Woerdet al., 2004). Depending on their global reach and the kind of businesses and activities they engage in, companies must adhere to various regulations. Public pressure to address climate

change is, in part, company-specific because it frequently has to do with the reputation a firm has developed through time.

As a result of shifting weather patterns or resulting government policies, some businesses are directly impacted by climate change, while others are more indirectly involved through their stakeholders, generally construed. As stated in the call for papers for the 2006 EABIS conference, the importance of many strategic management dimensions is clearly demonstrated by the issue of climate change in light of these uniqueness.

Stakeholder, resource-based, institutional, and supply-chain perspectives are all crucial for describing and comprehending the present corporate strategic approaches to this sustainability issue. In order to better understand what "strategic stakeholder management," as stated in the call for papers, would mean in this situation, we shall examine many facets of climate change in this essay. Kolk et al. (2008) believe that this is a contribution to both research and practice given how crucial this problem is for corporate sustainability.

Due to their initial focus on an academic audience and standard publishing practices, the empirical publications in this body of work in particular adopted, in the majority of cases, a specific theoretical approach. With a stakeholder perspective as its starting point, this conceptual paper seeks to establish a more comprehensive viewpoint. Then, taking into account societal and competitive settings, this will be connected to company climate strategies and corresponding competencies (Kolk et al., 2008).

As a result, we give an overview of the various aspects of climate change that are pertinent to business and suggest areas for more empirical investigation for scholarly reasons.In order to clarify what a "strategic stakeholder management strategy," as indicated in the EABIS call for proposals, would involve, this study has looked at several aspects of climate change, a subject that amply illustrates the various facets of strategic management.

By demonstrating how climate policies at various organizational levels can be connected to the social and competitive settings that businesses must contend with, anchored in a stakeholder perspective, it hoped to effectively convey this concept. The current example of an environmental problem that predominantly affects business comes from stakeholders who are attempting to have an impact on corporate goals: climate change.

Companies have three different sorts of strategic alternatives, each targeted at a particular stakeholder group, to react to or anticipate this stakeholder pressure. Companies prioritize specific stakeholder groups based on factors like location, geographic dispersion, sector, and diversification, which is represented in their climate strategies, which include internal measures, supply-chain measures, and/or market-based measures that go beyond the supply chain.

The arguments presented in this work are supported by further empirical data from the authors' earlier publications. The present study has attempted to develop a more integrative approach in comparison to that output, which typically adopted a specific theoretical perspective. It does this by demonstrating how institutional, resource-based, supply chain, and stakeholder views are all significant in characterizing and understanding company's strategic responses to a

sustainability issue. Throughout the process, a summary of many components related to business and climate change has been provided. We have recommended areas for future empirical investigation for scholarly reasons.

Walls et al. (2012) claim that one of the organizational fields that has been the subject of the greatest research and a recurring issue of discussion among academics, business journalists, and public policy makers is corporate governance. Financial performance is the primary emphasis of the discipline of corporate governance, which covers a wide range of problems.

However, corporate scandals like the now "classic" ones involving Enron, WorldCom, and Arthur Andersen, as well as more recent ones involving Wall Street financial institutions like AIG, continue to fuel the argument over whether businesses should include social objectives in their corporate goals or only concentrate on maximizing shareholder returns (Margolis & Walsh, 2003).

This has led to more people becoming concerned about the governance of firms and the governance frameworks that can successfully influence social business activity. Corporate governance discussions have gradually evolved since the turn of the twenty-first century to contemporary societal issues that matter to customers, legislators,shareholders, and corporate management in the marketplace. This has occasionally led to changes in legislationand even a shift in consumer preferences.

Several non-profit organizations have formed in the wake of the recent global financial crisis to emphasize the critical need of identifying governance systems that may incorporate social aims as part of everyday company activities. For example, voluntary initiatives like the OECD Principles, UN Global Compact, IFC (World Bank Group), International Corporate Governance Network, and others encourage businesses to include social issues in their governance agenda and acknowledge that a company's environmental, social, and governance responsibilities are crucial to its performance and long-term sustainability (Choua & Tsengb, 2015).

Despite the advancements achieved in our comprehension of how societal issues may affect corporate governance and vice versa, there is still room for more research into this relationship. Firstly, the research is not being informed by any dominant paradigm. Instead, a number of theoretical frameworks that frequently have different underlying assumptions have been used.

Additionally, prevalent frameworks in corporate governance research, such as agency theory, fail to adequately explain why and how social targets ought to be incorporated into company strategic goals.Secondly, just a small fraction of known corporate governance characteristics is examined in most studies. However, it is well known that various governance systems frequently interact with one another at various levels of analysis and do not function in isolation such as ownership, board of directors, and managers.

However, Johnson & Greening (1999) and Neubaum & Zahra (2006) show a substantial, positive relationship between institutional ownership and corporate social responsibility (CSR).For instance, Graves & Waddock (1994) find no relationship between institutional ownership and CSR. While these studies show excellent effort, Berrone & Gomez-Mejia (2009) note that considerable work needs to be done so as to comprehend the relationship between social issues and managerial remuneration.

Thirdly, even though CSR is a multifaceted concept and that businesses typically approach social and environmental issues differently, the research does not distinguish between different types of CSR (Bansal et al., 2014).

Walls et al. (2012) reexamine this intricate and rich organizational phenomenon by going back to its facts because of the growing significance of CSR in corporate governance, the lack of a solid theoretical foundation, the ambiguity of the findings, the need for multilevel analysis, and CSR's multidimensionality (Daft & Lewin, 1990). Therefore, they narrowly focus our analysis of the relationship between corporate governance and CSR by just taking the environmental performance component into account in order to gain fresh understanding from our analysis of the patterns in the data. As a result, future academics will be able to explain how and why this phenomenon happens by reporting the findings of the "stylized facts".

The sample of this study is the Standard & Poor's (S&P) 500 companies from the primary and manufacturing industries. They assembled an unbalanced panel dataset between 1997 and 2005 using data from the various sources and in case of data was lacking then observations were removed. In total, 313 firms (2,002 firm years) across 29 industries made up our final sample. According to the results of the study between 119 (in 1997) and 298 businesses were included in each of the eight years of our research (in 2003). A firm's panel lasted, on average, 6.4 years. Five industries (food, chemicals, manufacturing, technology and instruments, and electric/gas/sanitary services) collected about 64.3% of the businesses.

Except for 2004 and 2005, where performance was generally better, environmental strengths outcomes, which varied from zero to four, were evenly distributed across all years. A quarter of the sampled companies reported having at least one environmental strength, whereas only 12 out of the 29 industries had any environmental strengths at all. The chemical industry had the highest number of environmental strengths.

Additionally, the manufacturing of furniture, transportation equipment, and instruments received higher scores than other industries for environmental strengths. Results for environmental issues were evenly spread across all years, ranging from zero to six, with 36.8% of businesses reported having at least one environmental problem. Non-metallic mining, tobacco goods, leather products, stone/clay/glass products, motor freight transportation/warehousing, and air transportation are some industries where there were no businesses with any environmental issues.

The amount of S&P 500 companies encompassed by these industries was surprisingly small, despite this. In the petroleum refining sector, there were the most environmental issues. Chemicals, gas/electric/sanitary services, primary metals, transportation equipment makers, oil and gas extraction, and oil and gas refining were some other businesses with somewhat high levels of environmental issues.

Moreover, board size and CEO compensation linked with business size, as did shareholder concentration and institutional ownership. Environmental board committees and firm size both moderately connected with environmental concerns.

Overall, this fact-based research revealed numerous important relationships between corporate governance and environmental performance, many of which went against the grain of the prescriptive predictions made by the theories that had been used in earlier studies. Additionally, they discovered linkages between the corporate governance factors that characterize the event in more nuanced ways than those observed in earlier research.

Generally, ownership components of governance are crucial for addressing environmental strengths, whereas board aspects are significant for addressing environmental issues. In addition, relationships between ownership and the board are relevant for environmental issues, but interactions between ownership and management and between the board and management are essential for environmental strengths.

Von Schickfus (2011) shows that the value of fossil fuel-based technologies may decline in comparison to "green" technologies as climate rules become more stringent. This indicates that the market value of enterprises with considerable fossil-based knowledge is at jeopardy. The financial market participants, particularly institutional investors that use long-term investing strategies, should be aware of this technological risk.

This research employs a dynamic patent count data model to measure technological knowledge using patent data at the business level, and it investigates whether institutional investors manage the risk of technology transition through engagement activities. This study examines the impact of institutional ownership on the direction of innovation using firm-level panel data. The Orbis database serves as the primary data source. It distinguishes between various investor categories and provides yearly information on the shares of each owner in the total market capitalization.

This makes it possible to figure out the percentage of all institutional ownership by company and year, as well as the shares of various investor categories. For instance, it would be assumed that UN PRI signatories or investors with long time horizons (such as pension funds) would be more interested in future climate risks than the typical institutional investor. Orbis and other data providers are used to gather additional firm-year specific control variables.

Moreover,the author created a global firm-level panel on institutional ownership and patents. To assess the technological innovation and expertise of a corporation, patents are divided into categories for green and fossil technologies. Then, based on Aghion et al. (2016), a dynamic

patent count data model is estimated, where patenting is dependent on prior knowledge, spillovers, R&D activities, and the percentage of institutional ownership. A control function method addresses the endogeneity of institutional ownership.

Also, the author discovers solid proof of institutional ownership's beneficial effects on overall patenting activity. However, there is no proof that either fossil or green technology will be affected, not even for long-term investors or those who have signed the UN Principles for Responsible Investment (UN PRI). The association between "climate opportunity exposure" and subsequent green variation is found to be significantly positive by the author.

Furthermore,reputational issues, or the lack of them, may be a factor in institutional ownership's lack of impact on both fossil and green technologies. The lack of a relationship between institutional ownership and patenting on climate-relevant inventions may also be explained by the fact that policy uncertainty has been demonstrated to inhibit innovation.

Investors may choose to encourage innovation in other areas rather than wager on green or fossil technologies given the uncertainty surrounding climate policy. Examining events that lessen policy uncertainty and the ensuing market valuation of green and fossil patenting would be a significant next step in this line of research. Although there is strong evidence that institutional investors have a favorable impact on innovation as a whole,there is no evidence that institutional ownership is related to a shift in the direction of innovation.

Kruitwagen et al. (2017) examine how equity owners and management interact with businesses that face climate change threats. Companies and shareholders with predictable traits in their engagement or divestment decisions regarding carbon risk are identified and parameterized.

In doing so, the paper suggests a few psychological (such as memory and foresight) and situational (such as multiplicity of investors, benefits, and costs) factors that may shed light on the development stewardship theory (such as Davis et al., 1997) and its connection to agency theory.

In order to understand the dynamics of engagement methods, simple models are constructed and used to the relationship between businesses and equity owners. Semi-structured interviews with experts in the financial sector, the oil and gas business, the NGO, regulatory, and academic sectors provided the basis for the work.

Moreover, the non-cooperative social dilemma games were utilized to gain understanding of the prerequisites for effective investor stewardship of businesses. To investigate the prerequisites for agent collaboration in pairs and groups, prisoners' dilemmas were iterated. Semi-structured interviews with experts in the energy and banking industries as well as the NGO/regulator/academic sectors informed the games and insights created.

The disproportional impact of costs relative to benefits, low discount factors, constrained foresight horizons, and sensitive memories were among the obstacles to mutual cooperation and coalition formation in engagements.

Coalition building among sizable shareholder groups is challenging due to the temptations of free-riding growing in larger organizations. Innovative solution models, such as side payments and social network processes, can guide the creation of frameworks for reliable investor coalitions. In order to reduce exposure to environmental risks, asset owners' long-term interests are driving sustainability performance in the businesses in which they have investments.

There are still difficulties in overcoming short-term defection between investors and business boards for investors who want to influence corporate behavior. In order to provide investors with information about when their participation with sustainability concerns will be most beneficial, this study has defined conditions for reciprocal cooperation.

In order to exert greater influence with enterprises, investors must overcome free-riding temptations and forge stable coalitions with other investors. This research provides investors with more information to help them decide whether to engage, withdraw, or divest.

The main contribution of this work is the possibility of making engagement and divestment decisions objectively, based on underlying environmental hazards and the efficacy of investor stewardship and involvement.

Kolk & Pinkse (2008) examine at how businesses have responded to climate change in relation to the creation of procedures for reporting greenhouse gases, specifically carbon disclosure. In order to understand the role of carbon disclosure in the developing climate regime, it first provides some background information and context on the development of carbon trading and disclosure.

It then develops a conceptual framework using theories of global governance, institutional theory, and commensuration. Then, with a special emphasis on the Carbon Disclosure Project, a closer examination is given to carbon disclosure and reporting procedures (CDP). According to thisstudy of the responses, CDP has been successful in pressuring businesses to provide substantial information on their climate change initiatives.

Although response rates in terms of the number of declaring companies are impressive and rising, neither the degree of carbon disclosure that CDP advocates nor the more thorough carbon accounting at this point give data that is very useful for investors, NGOs, or policy makers.

Carbon disclosure has made some technological progress as a project of commensuration, but far less in terms of the cognitive and value dimensions. The authors focused particularly on the Carbon Disclosure Project, which was founded in the UK with significant support from institutional investors in the UK. The analysis of response patterns reveals that European firms have been the most active in completing the questionnaires, although the gap with North American and particularly Japanese firms has narrowed in recent years.

The study has grown over time to include more investors from other regions as well. In terms of the quantity of reporters and support from illustrious investment banks and pension funds, CDP has undoubtedly achieved great achievement. This in some ways illustrates a process of global convergence and successful institutionalization. Despite the relatively outstanding response rates, a closer examination of the data provided by the companies who responded to the survey casts doubt on the apparent success of CDP.

There has to be more parity between the level of carbon disclosure reporting that CDP supports and the more in-depth method of carbon accounting. The readability of carbon disclosures is still debatable when it comes to the contents of businesses' submissions to the CDP, which can be seen of as a type of civil regulation. It is highly challenging to gain insight into reported emissions, let alone firms' real accomplishments, because to the frequent lack of disclosure of the forms and meaning of emissions data as well as reliability checks. Even seasoned analysts of emissions and climate change statistics struggle to understand company reporting under CDP.

Several differences and replies that sounded implausible were discovered in a discussion article from 2006 that examined several samples of CDP responses from the viewpoint of a financial analyst/institutional investor. This raised concerns about the utility, in particular, for investors. Therefore, despite rising response rates and rising amount of responses, there is little to no proof that investors are using the data to aid in their decision-making. This expanded definition of value commensuration has not yet been institutionalized in any significant way.

Despite helping to draw in a lot of investors, the fact that signing up for CDP puts no obligations on the signatories hasn't resulted in a stronger or more binding relationship between information "users" and disclosing corporations. Even with these shortcomings, the rising data availability offers opportunity for deeper analyses of business responses to climate change, both generally and especially with relation to carbon accounting and reporting.

Expected upcoming carbon trading systems, at different levels, will give businesses more of an incentive to expand their disclosure, management, and accounting linked to climate change, providing data for investigations into the relationship between business and climate change in diverse contexts.

Also, Velayutham (2014)examines how corporate governance practices affect how much information about greenhouse gas emissions is disclosed, as well as how closely earnings management and share liquidity relate to this information. The sample for this study is made up of publicly traded Australian companies that, from 2006 to 2009, voluntarily revealed their greenhouse gas emission data through channels such the Carbon Disclosure Project, annual reports, standalone sustainability reports, and company websites. The approach used in this study to score greenhouse gas emission disclosure quality is taken from the 2010 Carbon Disclosure Project.

The information supplied on company websites as well as the voluntary disclosures made in annual financial and sustainability reports were graded using content analysis. The impact of corporate governance mechanisms on greenhouse gas emission disclosures and the degree to which the disclosure of greenhouse gas emission information is associated with earnings management are both examined in this thesis.

The two opposing views, the stakeholder value maximization view and the shareholder expense view, are examined. In order to satisfy the legitimate interests of stakeholders, the stakeholder value maximization perspective predicts that businesses will take part in socially responsible activities like greenhouse emission reduction strategies and targets related to climate change. On the other hand, the shareholder expense perspective contends that businesses invest in socially responsible projects like those to reduce greenhouse gas emissions at the expense of their shareholders. This study adds a number of fresh results to the body of knowledge.

First, this thesis has found that there is a relationship between effective corporate governance mechanisms and voluntary disclosure, such as greater board independence, the absence of Chief Executive Officer duality, the presence of gender diversity on the board, a decrease in directors' share ownership, an increase in institutional ownership, and a smaller size of the audit committee.

These findings imply that businesses with strong corporate governance practices prioritize a wider range of stakeholders' legitimate interests in relation to climate change, notably mitigation targets for greenhouse gas emissions. In contrast to the shareholder expense hypothesis, which is based on agency theory, this is congruent with the stakeholder value maximization view of firms, that is based on stakeholder theory and legitimacy theory.

The Heckman two-stage sample selection method can be used to control for self-selection without affecting the results. Our findings hold up well when financial sector companies that may be impacted by the global financial crisis are excluded. Second, this study discovers a tenuous inverse link between earnings management and voluntary disclosure of greenhouse gas emission disclosure.

The stakeholder value maximization theory has received only little support from this study, which suggests that stakeholder-focused businesses are less likely to practice earnings management. Additionally, Australian businesses strive to strike a compromise between the quality of financial reporting and the quality of disclosure of greenhouse gas emissions. The result is that they struggle to accomplish several goals at once. The two-stage least squares technique

yields findings that are resistant to endogeneity controls. Thirdly, our research has discovered that a company's stock's liquidity may be impacted by its decision to voluntarily disclose information about its greenhouse gas emissions.

This shows that companies that voluntarily publish more information about their greenhouse gas emissions benefit better share liquidity. These findings have a direct impact on the share liquidity of their companies.

By voluntarily disclosing more information about their company's greenhouse gas emissions through the Carbon Disclosure Project and other corporate reporting channels, managers can influence the liquidity of their shares. Finally, because of social constraints, larger, more well-known companies tend to share more information about climate change-related issues.

Less information on greenhouse gas emissions is typically provided by businesses with more growth potential. Age and firm leverage are positively correlated with the quality of greenhouse gas emission disclosure, suggesting that older, more seasoned companies with greater leverage may disclose more about the quality of greenhouse gas emissions to uphold their reputation among stakeholders.

Furthermore, companies must take responsibility for the problem by making the transition to net zero by 2050 as they are the primary causes of climate change. The incorporation of sustainability or ESG aspects into business operations has become a top priority for policymakers, regulators, and many stakeholders, including investors, according to Gözlügöl (2022).

However, as the "environmental" component of sustainability or the ESG agenda gains prominence, it is important to be aware of any potential conflicts with the social component or interests. The net-zero transition will not be inclusive by default, particularly in the context of climate change. The workforce and communities may suffer severe negative repercussions in some areas and industries, such as the energy sector.

As has previously been observed at the national level, if these consequences are not properly controlled, the process of moving toward net-zero in businesses may be slowed down or impeded. Or, a transition that ignores social implications could lead to an unequal distribution of the costs and benefits of tackling climate change, which would be detrimental to the social fabric.

Companies have a significant impact on a just transition as well. They ought to assess how their policies will affect their workforce and the communities in which they do business, engage in social dialogue with them, and take proactive measures to address any unfavorable effects, such as reskilling and retraining their staff members or facilitating their relocation to other locations or retirement. Utility companies have previously taken action in this area with varied degrees of success, demonstrating the feasibility of a just transition.

Bruno(2019) examines the difference between the climate corporate governance of Europe and the United States. Specifically, the European Directive N. 2014/95/EU, which requires information on the strategies adopted by significant firms on climate change risks and possibilities, is based on the logical premise that climate change is a financial factor. Climate change affects the European directors' duty of skill and care through disclosure. On the other hand, there are no federal laws or SEC rules that particularly address climate disclosure in the US.

American academics claim that, despite the possibility of future change in fiduciary obligations, the existing assessment of directors' fiduciary obligations under state law does not take into account the dangers and opportunities associated with climate change. In terms of climate risks and potential, the levels of transparency of US and EU firms are thus already very different. The financial industry may decide to direct funds to Europe as a result of this circumstance.

Institutional investors in the US have been attempting to boost disclosure through shareholder recommendations under Rule 14a-8, but recent SEC arguments against micromanagement have undercut these efforts. The study's conclusion is that the market cannot control climate change on its own and that regulation has given European businesses a greater chance of containing the "carbon bubble." The success of American corporations is on the line.

Climate change and other environmental, social, and governance (ESG) challenges have moved up the corporate agenda since the 2015 Paris Agreement. Companies are revising their strategy for a world with climate constraints as a result of increased pressure from institutional investors. Global climate targets are being worked on by governments all across the world. Climate change and broader environmental, social, and governance (ESG) challenges have also moved up the business agenda to the board level.

Companies are rethinking their strategy for a world with climate constraints across the corporate sector, and there is increased interest in experimenting with low-carbon goods and business models. As Governor of the Bank of England in 2015, Mark Carney alerted the financial sector to the potential effects of climate change on the value of investment portfolios. Executive compensation is being linked to climate targets, which is a novel feature of the rising corporate response. Climate measures now account for 8% of CEO short-term incentive schemes at the largest energy corporations in the world.

In December 2018, Shell declared that starting in 2020, it would link the CEO's and senior management's incentive compensation to overall company carbon targets. Under pressure from shareholders, a number of additional significant oil and gas corporations in 2019—including BP and Chevron—decided to include carbon objectives in executive compensation. One of the biggest miners in the world, BHP, incorporates a climate target into its CEO compensation; electricity firms are looking into related concepts.

Companies in other industries, such as heavy industry and transportation—including aircraft, aluminum, cement, and steel—face similar problems and are under increasing pressure to decarbonize. In summary, firms are starting to include carbon emissions as a major performance

metric in their management incentives as they become a driver of long-term company value. Ritz (2020), proposes a framework for comprehending the advantages and design difficulties of climate-linked management incentives and outlines the application of climate-linked management incentives to date.

A novel feature of the corporate reaction to the low-carbon transition and ESG-driven pressure from institutional investors is executive compensation tied to company-level climate targets. For their senior executives, a number of energy corporations now use climate-related incentives, and mining and electricity businesses are also seriously considering the notion. For other industries with high pollution levels, such as aviation, aluminum, cement, and steel, the problem will get worse.

Carbon emissions are becoming a critical performance measure, which would have appeared astonishing even five years ago, and the financial sector may end up playing a significant role in the fight against climate change. Businesses that understand that their long-term worth is correlated with their climate performance can benefit from climate-linked incentives in a variety of ways. They can improve the organization's management incentives' alignment with high-level business strategy.

They aid in institutionalizing the process by which consideration is given to the effects that corporate actions will have on the climate at the board level. They can add more weight to ESG measures in a company's balanced scorecard, sending a positive message to institutional investors and potential workers about the direction of the company's operations. The application of climate-linked incentives has included some experimentation up to this point, and there will be room for improvement throughout time.

Observing what works and then making tweaks to prevent unwanted repercussions is solid business practice. A key decision is whether to base incentives on emissions from one's own production or to take the supply chain into account. While incentive considerations lean toward the former, strategic factors are shifting in favor of the latter. "Holistic" climate incentives will gain popularity over time as emissions measurement across the value chain improves. Climate-linked incentives in the energy sector do not yet include comparisons to peers, in contrast to standard indicators like TSR.

The scope for relative performance evaluation will expand as the practice becomes more commonplace—to better reflect managerial contribution rather than "pay for luck." It should be especially appealing to emissions-intensive enterprises that want to change their operations to survive the low-carbon transition to tie top management incentives to climate targets. These businesses will have to be ambidextrous, re-optimizing older businesses to extract their remaining value while also making investments in cutting-edge low-carbon goods and technologies for future expansion.

There are many options for allocating capital between environmentally friendly and less environmentally friendly companies, and these decisions can be guided by tying management incentives to climate targets in addition to other sustainability tools like modified investment

criteria and the use of internal carbon prices. The oil and gas industry's past experience may provide a road map on how to tackle this difficulty in terms of incentive design.

Many large firms have implemented a range of carbon and energy management techniques, taken steps to reduce their emissions, and set targets to reduce their greenhouse gas emissions in response to pressure from governments, investors, non-governmental organizations, and other stakeholders. Sullivan &Gouldson (2017) investigate whether, and under what circumstances, non-state entities could be able to take over the governance functions that have historically been played by national governments using the case of transnational merchants.

This paper emphasizes the significance of taking into account internal governance conditions, external governance demands, and the degrees and modes of interaction between them. It demonstrates that external forces, internal governance structures, and corporate responses to climate change interact and have an impact on one another, and that it is crucial to analyze these factors together rather than separately.

The nation case studies also demonstrate how context-dependent differences in the specifics are caused by intricate processes of influence, interaction, and co-evolution over time. The alignment of various pressures and situations is emphasized in this research as a crucial factor in determining their power as a unit and their capacity to affect corporate behavior.

It implies that in order to govern or influence how corporations respond to climate change, policymakers or other stakeholders need to empower a variety of actors. These actors also need to be recruited and engaged in order to identify areas of shared interest (or alignment), and if they are to make significant changes, they must act continuously and strategically.

The information offered here illustrates the potential impact of internal governance conditions as well as external governance forces, but it also emphasizes the constraints set by the business case for action. It is not at all obvious to what extent external governance forces might compel businesses to take challenging or disruptive changes that go beyond the scope of the business case.

According to evidence from the retail industry, the companies in the sector have, at least in regard to their own operations, increased their energy efficiency, decreased their emission intensity, and, to a lesser extent, decreased their greenhouse gas emissions. Since there is little to no meaningful government regulation, they have repeatedly done this.

This shows that new governance structures that depend less on the power of the state and more on the influence of private and civic actors may be effective. These enhancements, however, are largely based on incremental change and are reliant on a sound business case. The bounds of the business case and incremental change can undoubtedly be expanded through learning.

However, the potential for new governance structures to spur further advancement is likely to be constrained if the business case deteriorates or if the prospects for incremental change are exhausted. There are currently very few indications that any retailers are considering making significant changes to their business models, and none appear to see any alternatives to commercial expansion. Therefore, it appears that non-state actors have very little ability to compel them to consider such ostensibly disagreeable adjustments.

For sophisticated societies, energy corporations offer vital economic resources. However, some bemoan the environment and excessive profits. Experts in science and politics cite a wealth of research as adequate proof that climate change is not a big issue, whether it is caused by humans or not. For instance, Richard Lindzen referred to proponents of "global warming" as discredited alarmists while serving as the Alfred P. Sloan Professor of Meteorology at MIT from 1983 to 2013.

According to financial analysis, energy companies are less profitable than their counterparts in other sectors. Broker et al.'s (2019) results are important to academic researchers and business executives, especially if they are interested in the corporate governance of energy businesses. Managers of energy businesses would do well to underline the positive contributions of energy corporations to the global economy and to educate the public, government officials, and policy makers about the false accusations of environmental harm and excessive profitability.

Traditionalists contend that businesses' only social obligation is an economic one, i.e., maximizing profits (Friedman, 1970). Evidence, however, points to a different stance taken by organization officials. For instance, only one in six corporate executives, according to a recent McKinsey and Company study of businesses in 116 countries, agreed that the main purpose of business is to maximize returns for investors as opposed to balancing the economic function with contributions to the greater good.

Data suggests that businesses are increasingly taking on social responsibility for issues that are not immediately related to their operations or the effective delivery of goods—areas that were traditionally seen as legitimate governmental tasks (Harman & Porter, 1997; Matten & Crane, 2005). Corporate governance is crucial to the management and strategic direction of businesses (Hendry & Kiel, 2004; Kiel & Nicholson, 2005). The study of corporate governance has two main components.

First, the policy perspective can be used to examine corporate governance. Corporate governance of businesses, for instance, is expected to monitor the creation of long-term strategy as well as details like CEO hiring, firing, and remuneration, information disclosure, and transparency, and reactions to strategic challenges like climate change (Hendry & Keil, 2004; Keil & Nicholson, 2005). Board structure includes elements like the number of board members, the separation of the CEO and board chair responsibilities, the use of committees, and shareholdings (Finegold et al., 2007).

Studying board structure is essential because improperly constructed boards can result in high levels of inefficiency in the company's primary information processing center, which will ultimately have a detrimental effect on performance (Finegold et al., 2007). The research of the Coalition for Environmentally Responsive Economies is a foundational part Galbreath's study (2010). Founded in 1989, Ceres is a US-based nationwide coalition of investors, environmental organizations, and other public interest groups that collaborates with businesses to solve sustainability issues like climate change.

More than 50 institutional investors from the United States and Europe work together under Ceres' leadership to manage almost $3 trillion in assets through the Investor Network on Climate Risk. A number of studies that evaluate businesses' corporate governance procedures with regard to climate change have been commissioned by Ceres since 2003 in addition to the Global Reporting Initiative (GRI) launch in 1997.

The most recent research now evaluates 76 US corporations as well as 24 non-US firms, up from the original 20 US firms. Using five criteria—board supervision, management execution, public disclosure, emission accounting, and strategic planning—companies are graded on their governance practices that show a pro-active approach to combating climate change. The Coalition for Environmentally Responsible Economies (Ceres), which designed and investigated governance methods addressing climate change in 98 enterprises, provided the data for this study. Just under 30% of the sample came from nations other than the US, with the majority of the businesses being based in the US.

According to Ceres' grading methodology, corporations appear to be underperforming overall in terms of how well governance processes are tackling climate change. However, across all five of the evaluated governance dimensions, non-US enterprises score better than US firms. There may be institutional pressures behind the increased attention to climate change outside of the US. In terms of governance approaches that address climate change, companies with larger boards, separate CEO and board chair roles, younger directors, and a higher proportion of inside directors appear to do better.

As a result, a few significant policy suggestions are made in light of this study's findings. First, it does seem that board structure affects how effectively governance procedures address climate change. Contrary to agency theory, a very independent board does not seem to be the best configuration. In light of this, organizations shouldn't assume that high levels of independence are necessary to guarantee that shareholders' interests are maximized. Based on the results of this study, it appears that the recommended course of action is to achieve a balanced mix with regard to the membership of the board of directors. Second, the institutional context might be an underlying factor in this study's findings.

Firms may invest resources to proactively address climate change through governance practices where institutional pressures are high. Therefore, a suggestion is made that businesses make sure they are carefully researching the environment in order to recognize - and ultimately respond to - external pressures to address climate change. This proposal is based on the work of Aragon-Correa and Sharma (2003). Failure to do so could undermine the validity of a company.

Corporate governance must prioritize resilience, adaptation, and mitigation of climate change. Institutional organizations have been researching climate change for the past few decades because it has an impact on social and economic life worldwide. Corporate governance education is one of the adaptation to climate change needs that has been identified. Peker et al. (2019) study the initiatives taken by international organizations to help businesses adapt to climate change.

Building regional capacity for climate change adaptation through policies, programs, and projects in the developing regions is the approved output acceptance. Where there is a trend for economic expansion, extension papers play a part in the lives of the populace and the media. Some climate change-related challenges include regional industrialization, rural infrastructure development, social, health, and population issues.

International commitments must be met everywhere in the areas of education, gender development, involvement in sustainability, ecological sustainability, forestry, preservation of biodiversity, chemicals, and waste management. The ability to adapt to climate change is a key component of food security and sustainable agriculture. Data, data mining, and big data studies on climate change adaptation are emergency issues.

Upon looking at the annual reports (from 1992 to 2007) and stand-alone social and environmental reports (from 2002 to 2007) of five of Australia's highest energy-using companies, Haque et al. (2016) found that the level of climate change-related corporate governance disclosures presented by Australian companies appears to be low, though to a limited extent, it was rising over time.

The findings from Haque & Deegan (2010) prompt them to ask whether the apparent absence of corporate governance disclosures connected to climate change is a cause for worry, even though they have acknowledged requests for enhanced disclosures in this area.

Perhaps not, if no one actually looked for or utilized data on a company's climate change-related corporate governance policies (although from a sustainability perspective we might be concerned that people did not demand, or expect, information about an increasingly important aspect of corporate performance).

Alternately, it's possible that the initial disclosure index created and employed by Haque and Deegan was insufficient and/or failed to include crucial elements of corporate governance connected to climate change, making it an unreliable basis for judging the level of corporate transparency.

To put it differently, they investigate what information various 'expert' stakeholder groups (such as institutional investors, governing bodies, environmental NGOs, environmental consultancies, researchers, and accounting professionals) think businesses should disclose in relation to their climate change-related corporate governance practices using the Haque and Deegan disclosure index as a starting point.

According to climate change experts, what details about an organization's corporate governance processes connected to climate change should be disclosed to stakeholders so that they may assess the organization's commitment to combating climate change?What are some underlying causes that seem to prevent organizations from disclosing information regarding their corporate governance policies in relation to climate change?

According to the findings, there is a widespread unwillingness to be transparent about the initiatives made to deal with the serious issue of climate change. In relation to the issue of climate change, it was evident that the managers interviewed prioritized corporate profits, financial performance, and shareholder interests above those of the larger community as would be the case with most corporate managers given the current market systems.

The organization may have believed that disclosing information about climate change would be expensive and economically detrimental, which might account for the organization's lack of participation and propensity to be "rationally" ignorant of stakeholder expectations. So,engaging stakeholders, which looked to be lacking, may actually push certain difficult issues from the background and into the spotlight, which would not be in the best economic interests of the organization (and shareholders).

# Chapter 3:

# The Impact of Climate Change on VariousEconomic Aspects

## 3.1 Introduction

The value of assets, the financing mix of businesses, and the cost of debt and equity may all be impacted by climate risk. It could be believed, that since climate risk is merely one component of a company's overall business risk, these risks should already be covered by standard risk management systems. The difficulty in pricing and hedging these risks by market participants may be due to the complexity of climate change effects, including those related to biodiversity, migration, public health, and water conflicts, as well as investors' constrained rationality and the tragedy of the horizon. Whether climate hazards are being considered by companies and priced by markets is one of the primary themes being explored by current research. Studies evaluate the climatic risk to which a business or financial institution is exposed using a variety of measures.

Physical data, such as temperature or sea level, or the occurrence of natural catastrophes, like hurricanes or floods, close to the entity's headquarters, are included in the first set of metrics. In a second set of data, specialized organizations like France's Carbone 4 and nonfinancial rating agencies are improving their methods for measuring climate risk. Finally, some analyses also consider the potential for stranded assets as a result of developments related to the climate. As a result, the results of several publications that serve as samples of the kind of study being done on real estate assets, debt, and equity are provided in the following subsections.

According to Bernstein et al. (2019), who looked at over 460,000 residential property sales in the US between 2007 and 2016, coastal properties exposed to sea level rise (SLR) sell for about 7% less than comparable properties. This SLR discount is mostly driven by properties that are unlikely to be swamped within the next 50 years, suggesting that investors are pricing long-horizon SLR costs. The reduction is still 4% for homes that aren't expected to flood for nearly a century.

Additionally, SLR has no impact on rental rates, supporting the notion that the discount is brought on by anticipation of future harm rather than existing property quality. The evidence also

indicates that more experienced investors are responsible for this discount. The average SLR exposure discount for this market category is currently around 10%, and it has been rising over time.

## 3.2 The impact of climate change on debt and the cost of debt

The majority of studies in this field of study discover that organizations with high climate risk have higher debt costs. For instance, Painter (2020) finds when looking at municipal bonds in the U.S. that counties most likely to be impacted by climate change had higher underwriting costs and beginning yields. Delis et al. (2019) evaluate whether banks account for the risk of stranded assets using information on fossil fuel reserves from company annual reports. Due to incentives to switch to clean technology, fossil fuel reserves may soon lose their economic value.

Moreover, the authors discover that banks did not price climate risk prior to 2015. However, a 16-basis point rise in the cost of financing for a fossil fuel company with mean proven reserves after 2015 is emphasized. These findings hold up to a number of further experiments that control for the price of crude oil, the location of reserves, and various combinations of the fixed effect variables. Seltzer et al. (2019), focusing on the bond market, show that companies that pollute and companies that do poorly in terms of the environment, typically, have worse credit ratings and higher yield spreads. Businesses located in states with tougher environmental enforcement laws will see more pronounced results.

Prior studies mostly focused on transition risks. Ginglinger & Moreau (2019) concentrate on the effects of physical climate risks on enterprises' leverage and the cost of debt. Specifically, the CRIS (Climate Risk Impact Screening) approach created by a French business, Carbone 4, is used by the authors to calculate the climate risks for each company included in the MSCI World Index. The World Bank Climate Portal's risk forecasts, the spatial division of activities, country- and industry-specific vulnerabilities, and CRIS ratings are used to quantify these factors.

The results show that in the years following 2015, lower company leverage is correlated with higher climate risk. Additionally, they draw attention to the fact that after 2015, businesses with a high level of climate risk had to deal with rising interest rates on bank loans as well as rising issuer bond yields. According to the research, bondholders pay four times as much for climate risk than bankers do. A knowledge advantage or effective financial regulation may be to blame for the discrepancy.

The disparities may be comprehended in how climate risks affect borrowing costs for bank loans versus bonds by recognizing that the level of credit ratings does not yet represent physical

climate concerns. The recent acquisition of extrafinancial rating companies by major credit rating agencies has strengthened their competence in assessing climate risk and suggests that the credit ratings they give will soon better reflect climate risk.

## 3.3 The impact of climate change on stock markets

A number of publications attempt to evaluate how climate risk affects corporate value. Other publications outline methods for mitigating climate threats.While some papers demonstrate that the markets do not take climate risk into account, others provide evidence of actual stock price consequences. The utilization of several data sources and the analysis of various time periods contributed to the variations in results. These outcomes are also a result of the challenges associated with making market predictions too early.

The Palmer Drought Severity Index is used by Hong et al. (2019) to calculate how susceptible a country is to droughts as a result of climate change. The consequences of predictably deteriorating droughts on agricultural enterprises are not anticipated by equity markets until after they manifest, according to the authors' analysis of stock returns in the food industry across nations during the sample period of 1985 to 2014. According to Batten et al. (2016), the market's response to climate change news for oil and gas companies was minimal between 2011 and 2016.

This could indicate that investors find it challenging to predict how climate legislation will affect the share prices of these companies. Bolton & Kacperczyk (2019) even discover an unexplained carbon premium using Trucost data. The value of stocks is indeed impacted by climate conditions, according to other publications. Using a textual analysis-based firm-specific climate risk metric, Berkman et al. (2018) discover a negative relationship between firm value and climate risk.

A plethora of studies looking at how a rise in temperatures affects the economy discover that stock prices are affected. Bansal et al. (2016) find that long-run temperature shifts have a significant negative impact on equity valuations: on average, a one-degree Celsius increase in the temperature trend results in an approximately 8.6 percent decline in equity valuations. They do this by using a standard and widely used set of 25 Fama and French book-to-market and size-sorted portfolios from the U.S. capital markets.

Nearly all equities portfolios have a negative temperature beta, and the authors' findings are also true for international markets (48 countries). The research shows that as temperatures have risen over time, so too has the premium for long-term temperature concerns related to global

warming. The authors claim that the temperature can tell us how likely and severe upcoming natural disasters will be. Hugon & Law (2018) discover that an abnormally warm temperature has a detrimental effect on enterprises' earnings, on average.

According to economic data, a 1°C increase in temperature over the long-term average is linked to a 1.6 percent drop in profits the following year, with the warmest quintile bearing the brunt of the adverse effects. Additionally, it appears that the summer effect is greater than the winter effect. According to the authors, an abnormally warm temperature results in lower sales and higher expenses, with the latter being more than the former. Not all businesses, meanwhile, are affected by high temperatures. One-third of the businesses are winners, meaning they respond favorably to a warmer climate. For instance, this is the situation with 53% of healthcare businesses.

# Chapter 4:

# Different Types of Risks and their Impact onVariousEconomic Aspects

## 4.1 Physical Risks

Physical risks are those that result from the interplay of climate-related hazards (such as dangerous events and trends) with human and natural systems' exposure to danger and their capacity for adaptation. Extreme weather threats from heat waves, severe precipitation, and coastal floods are already "moderate," according to IPCC (2014).

In comparison to the 1986–2005 era, these risks will increase by 1$^{o}$C with more warming, and risks related to some extreme occurrences (such intense heat), grow steadily with extra warming. The degree of the scientific evidence connecting climate change to the propensity for particular risks varies. For instance, according to IPCC (2014), there is some evidence that climate change is associated with a decrease in cold temperature extremes and an increase in high temperatures, an increase in the frequency of heavy precipitation events and an increase in the number of abnormally high sea levels (such as storm surges).

On the other hand, the evidence connecting climate change to the frequency and severity of river floods, droughts, and tropical cyclone activity is either more circumscribed or weaker, and it varies among regions, but connections have been shown in certain instances (Schaller,2016).

## 4.2 Transition Risks

The risks to the macroeconomy from the shift to a low (and ultimately zero) carbon economy. It means that the ability to increase energy efficiency (a reduction in energy used/GDP) and reduce carbon intensity of energy (a reduction in carbon/energy used) will determine the decrease in GDP growth required to achieve a given reduction in carbon emissions.

Smulders (2014) find that using a simple growth accounting paradigm, a 10% reduction in energy usage reduces output by about 1%. If a reduction in carbon emissions is to be achieved completely through a reduction in energy use, then the ensuing reduction in output might be significant.

On the other hand, the growth impact of a tighter regulation on carbon emissions can be anticipated to be reduced if the reduction in carbon emissions can be achieved through shifts to cost-effective low- and zero-carbon energy supply and higher energy efficiency.

This suggests that if adequate investment is made in low-carbon energy sources at an early stage, the transition to a low-carbon economy could be accomplished without producing a significant negative supply shock. The unpredictability of inflation rates may also rise if the shift is followed by an increase in the share of bioenergy since weather-related shocks may have an impact on both energy and food costs.

Even though this effect could be lessened as countries become wealthier by gradually reducing the proportion of food and energy in the consumption basket (and consequently, the consumer price index), it could be made worse by climate change, which influences weather patterns.

The risks of economic disruption and financial losses linked to the transition to a lower-carbon economy are known as transition risks. As we'll go over in more detail below, a seamless transition to a low-carbon economy is feasible if private investment in low-carbon technologies shifts quickly and steadily as a result of expectations that future policies governing carbon emissions will become stricter. In addition, delaying a transition indicates that the physical risks associated with climate change would probably worsen with time.

However, it is feasible that a hasty and late tightening of policy on carbon emissions could result in the "stranding" or loss of value, of investments that are carbon-intensive. Winners and losers may result from any economic shift brought on by increased regulation, but the overall effect will largely rely on how big the sectors are that are affected. For instance, the oil and gas industries alone make up 12.5% of the FTSE 100 index (as at 31 March 2016).

If it is possible to enhance energy efficiency (i.e., lower energy intensity of GDP)21 and reduce carbon intensity of energy, as summarized by the Kaya identity below, a significant reduction in CO2 emission can be achieved without a significant sacrifice in GDP growth:

$$\text{Carbon emissions} = \text{Population} * \frac{\text{GDP}}{\text{Population}} * \frac{\text{Energy used}}{\text{GDP}} * \frac{\text{Carbon}}{\text{Energy used}} \qquad (1)$$

Investments would consequently be needed to transition away from high-carbon energy production methods and toward low- and eventually zero-carbon energy production. The transition to a "low carbon" economy could be accompanied by sharp drops in asset prices, such as those of fossil fuels and businesses that heavily rely on their use, if investments in low-carbon energy production are not made in sufficient quantities and the policy on carbon emission is suddenly tightened (Carney, 2015).

## 4.3 Liability Risks

Parties that have experienced loss and damage as a result of physical or transition danger from climate change may seek restitution from those they hold potentially accountable. If such claims are upheld, the defendants will either have to cover the costs themselves or they may try to shift some or all of the losses to their liability insurance providers.

Liability and other legal risks are conceptually about how losses due to physical and transition hazards are distributed among various parties. According to Bank of England (2015), there are three main ways to prove liability:

1) Failure to mitigate: The claimant may assert that the defendant, such as an oil firm, changed the environment in a way that hurt them by releasing GHGs.

2) Failure to adapt: The claimant may assert that the defendant, with whom he or she has a contractual or other direct relationship, exposed the claimant to a higher level of weather-related losses by providing goods or services that were unsatisfactory in quality or unfit for their intended use, or that the defendant exposed the claimant to a higher level of financial losses by failing to account for the possibility of tighter regulation of carbon emissions.

3)Failure to disclose or comply: The claimant may assert that the defendant failed to disclose information pertinent to climate change in a timely manner, did so in a deceptive manner, or failed to comply in any other way with laws or regulations relating to climate change.

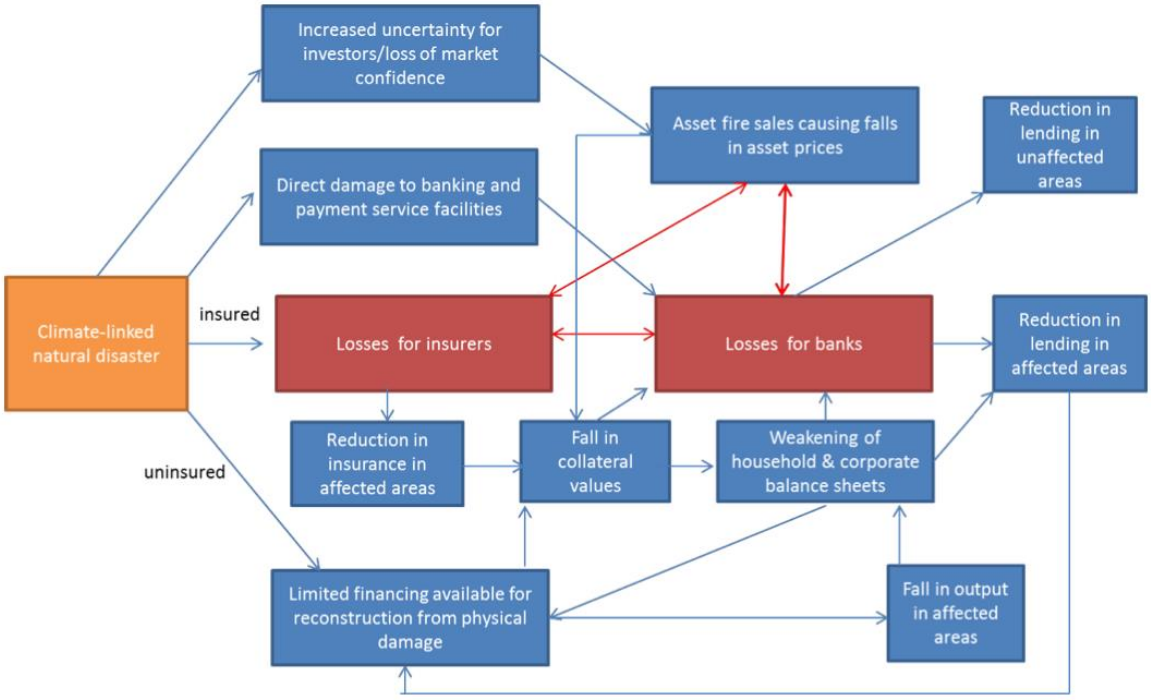
In conclusion, although successful regulations to re-direct private investment towards low-carbon technology could decrease this risk, the transition risk is most likely to damage the financial system as a whole.

Only when a weather-related disaster is really severe and impacts densely populated areas with large productive capacity is there a physical risk to the system as a whole. Specific institutions operating in the liability insurance market inside the system are more likely to be impacted by the liability risk.

## 4.4 Influence on economic aspects

Physical risks associated with climate change that materialize, such as natural disasters caused by climate change, have the potential to cause significant financial losses, some of which are covered by insurance and some of which are not. Figure 1 shows how losses from climate-related natural disasters may have an impact on the stability of the financial system as well as the soundness of specific financial institutions.

**Figure 1:** This figure shows the impact of a natural disaster on the macroeconomy, financial sector losses, and other factors




The presence of insurance institutions and the degree to which losses were compensated or not reflect the key differences in the transmission mechanism. The possibility that insurance

company failure must be considered, if insured losses brought on by catastrophic weather events are persistently high. Consequently, the availability of pertinent insurance services and products may be disrupted, with serious financial market repercussions.The quick sale of distressed insurers' assets would drive down asset prices, which could negatively impact the balance sheets of other financial institutions like banks. According to numerous studies, which are going to be presented below, insurers and reinsurers still frequently base their analyses primarily on historical data without taking climate change trends into consideration. Moreover, several organizations have started to take catastrophe models into account in their examination of the effects of climate change. Implementing strict financial regulation and supervision, the dangers of banks defaulting may be reduced. In comparison to bank clients in developing nations, borrowers in developed countries tend to have greater insurance and banks tend to have well-diversified asset portfolios.

According to Choi et al.'s (2019) research, the number of Google searches related to climate change rises when there are heat waves. Extreme local temperatures can alert investors to climate change, particularly during heat waves when media attention seems to be at an all-time high. The authors find that when the local exchange city is abnormally warmer in a given month, carbon-intensive enterprises experience poorer stock returns than other firms for the period of 2001–2017 for 74 major stock exchanges around the world.

Retail investors sell high-emissions companies and buy low-emissions companies, according to their research, however institutional investors do not consistently react to regional warming. Retail investors respond to notable short-term weather events, despite the fact that they are uninformative of the actual climate trend, even though global warming is a long-term trend. However, the actions of investors actually affect prices and trade activity.

According to Alok et al. (2019), all funds experience a post-disaster decline in the portfolio weights of stocks from disaster zones, but close funds experience this decrease more than distant funds do. This difference in difference strategy is used to demonstrate this difference. This outcome might be the consequence of a salience bias, whereby fund managers who are close by and who also reside in the disaster area exaggerate the disaster's effects, or it might be the result of an informational advantage.

However, the post-disaster difference in performance between businesses in the disaster zone and those in the near-disaster zone is statistically equivalent to zero. Alok et al. (2019)verify the salience bias of funds managers by several other tests. Not just fund managers overestimate the effects of natural calamities. Dessaint & Matray (2017) discovered that during a disaster, managers of businesses nearby impacted areas but not themselves tended to hold extra income. These findings imply that due to the salient effects of these occurrences, investors exaggerate the implications of acute physical hazards.

Furthermore, the literature currently in print identifies a variety of ways that climate change may slow the potential rate of economic expansion. First of all, a slowing down of the growth of

the labor force as a result of lower labor productivity brought on by deteriorated mental and physical capabilities of human capital. Specifically, an extreme heat may also decrease the amount of labor available by raising population mortality and morbidity rates, for instance as a result of an increase in the prevalence of diseases like malaria (Frankhauser & Tol, 2005).

Deryugina & Hsiang (2014), for instance, used variability across counties in the United States over a 40-year period to find that production decreases by around 1.7 percent for each 1°C increase in daily average temperature over 15°C. Secondly, a slower pace of productive capital creation due to long-term or irreversible damage to property and assets (Stern, 2013), or a faster rate of capital depreciation (Frankhauser & Tol, 2005).

Thirdly, a slower pace of total factor productivity increase as a result of the resources being diverted from research and development to adapt to the changing climate (R&D). Additionally, if adaptation necessitates greater expenditure in maintenance and replacement, there may be fewer productivity gains from "learning by doing" than there would be if greater investment were made in innovation (Pindyck, 2013; Stern, 2013).

Ignoring these impacts may cause central banks to underestimate inflationary pressure and the growth of the production gap. However, as the rise in global temperatures itself is anticipated to be restricted during this time, the impact of these impacts in the first half of the 21st century could be minimal. Even though there are uncertainties surrounding the current global temperature estimates, this may indicate that the authorities in charge of monetary policy do not necessarily need to take these consequences into consideration for the foreseeable future.

Climate risk, which is a highly ubiquitous systemic risk, will soon touch all asset classes, industries, and economies. Daily scientific advancements, particularly those made by IPCC (2014), provide proof that the climate can significantly affect how well our economic system functions. For natural and human systems, "*climate change will increase already-existing dangers and generate new risks*" (IPCC, 2014).

# Chapter 5:

# Corporate Governance

## 5.1 Definition and Objectives

The concept of corporate governance cannot be considered as one-dimensional and its objective varies according to the system that has been adopted, depending on the philosophy that corporate governance will express. Due to the fact that corporate governance cannot be studied under the lens of a single scientific discipline, many definitions have been given for it, some of which are listed below.

Corporate governance is defined as a set of legal, traditional, and institutional arrangements, which set the limits for the framework of action and the individual actions of open companies, giving answers about the person who controls them, the way in which the control is exercised and of the way in which the risks and returns from the business activity are distributed (Khan, 2011). Thus, corporate governance covers the mechanisms that form the initiatives, disincentives, and prohibitions, in light of which the management of the issuer of securities makes decisions (Claessens, 2006).

Another definition is that corporate governance relates to the ways in which providers of financial instruments ensure a return on their investment. These are the ways in which suppliers of capital to businesses ensure a profitable return on their investments (Abdullah & Valentine, 2009).

Corporate governance covering the structures, procedures, principles, and systems that promote the successful conduct of a business's affairs. Therefore, another definition of it could be the system based on which the direction and control of commercial companies is carried out (Hilb, 2008).

Finally, as corporate governance is considered the overall system of some procedures, rights, and controls, which have been established in terms of the management of the business, internally as well as externally, aiming to protect the interests of all involved factors in the corporate activity (Wieland, 2005).

The above procedures constitute mechanisms other than the exercise of rights to influence management, such as works councils. The above rights may be statutory or regulatory or contractual in nature. The above controls are mechanisms through which all involved factors are informed about the company's activity, such as internal control (Clarke, 1998).

The objective of corporate governance is not only to ensure the ownership and integrity of the business, but also to promote the efficiency and development of the business operations, leading it to profitability. Corporate governance is considered to be the set of trends and legal relationships that are manifested and established in the light of the operation of the company, whether its operation takes place under normal conditions of healthy exercise of its activity, or it faces financial difficulties (Alabdullah, 2014).

Briefly, the objectives of corporate governance according to theories are the following seven: (a) Discipline: The expected remuneration of executives in connection with the value of the shares, (b) Transparency: The company publishes its annual financial statements, (c) Independence: The chairman is an independent non-executive member, (d) Accountability: Board members and management committee members are significantly different, (e) Accountability: There are mechanisms to impose penalties in case of mismanagement, (f) Impartiality: Voting methods are easily accessible and shareholders have the right to convene a General Meeting of shareholders, (g) Social awareness: The company is environmentally conscious (Agrawal, 2012; Friese et al., 2008; John et al., 2016).

Therefore, corporate governance is not limited only to the business management model but it is a method of approaching the issues with the principle of trends which generally arise during the operation of the business. Thus, corporate governance determines the rules for exercising power in a business (Luo, 2005).

In conclusion, we could say that corporate governance includes all the provisions that allow to ensure the legality of the objectives of the company's management and the appropriateness and adequacy of the means that have been applied for the realization of these objectives.

## 5.2 The principles of corporate governance

In 1999, the Organization for Economic Development and Cooperation (OECD), with the Corporate Governance Code, published the basic principles that should govern any Corporate Governance arrangement. These principles are the basis of corporate governance and the point of reference for all countries in their efforts to implement it worldwide (OECD, 2004).

The principles of corporate governance aim to contribute to the improvement of the legislative and regulatory framework of countries regarding the implementation of corporate governance, at a global level. In 2004, due to the intense developments that occurred in the business world, OECD (2004) published the revised principles of corporate governance, which included the following:

(a) Protecting the rights of shareholders and the basic functions of business ownership, (b) Ensuring the equal treatment of shareholders, (c) Recognizing the rights of participants and encouraging active cooperation between businesses and participants, (d) Ensuring the timely and accurate disclosure of all material matters concerning the business, (e) Ensuring the strategic guidance of the business, the effective control of management by the Board of Directors and the Board's accountability towards the business and shareholders (Du Plessis et al., 2018; OECD, 2004).

## 5.3 The agency theory

The Agency Theory is the oldest theory of the corporate governance. It was developed in the modern era, by the work of Berle and Means, who studied the separation of ownership from the control and supervision of a business (Bendickson et al., 2016).

The shareholders due to various reasons such as the lack of knowledge and skills, the need to invest in several companies at the same time (diffusion of risk), the lack of time, the high cost of management and control of the business, etc. entrust the management of the company to professionals – representatives (Panda & Leepsa, 2017).

These representatives assume authority over the company's assets and human resources, as well as responsibility for their management. Thus, between the shareholder and the company, a substitute person is inserted, in which it is deemed necessary to check, in terms of the effectiveness and efficiency of the management exercised by him/her (Segrestin & Hatchuel, 2011).

The first four main admissible assumptions from the agency theory concern the persons (owners or principals and agents) and the remaining three the organization and are as follows: (a) The formal – legal commitment, as most mechanisms – contracts that use are binding and expressly defined, (b) The main motivation for their behavior is economic and therefore, the logic of their behavior is one-dimensional, economically rational, and predictable, (c) The adoption of opportunistic behavior. This means that their behavior is likely to change depending on the environmental conditions and based on their own interest and not on what they have been called to defend, (d) The risk aversion, which includes their evaluation of their potential actions with the relation of risk to the benefit they imply, (e) The possible incompatibility of the goals of the owners with the goals of the agents, (f) The criterion of efficiency, which includes the balance between the interested parties results from the performance of the actors (executives or main shareholders) and it is measured either by quantitative criteria or by qualitative criteria, (g) The asymmetric information between the owners - shareholders and the representatives (Saam, 2007; Worsham et al., 1997; Wright et al., 2001).

## 5.4 The stakeholder theory

It came from the recognition of the importance of the influences, power, and interdependence of a business from its internal and external environment. If a business ignores these interdependencies, weaknesses and threats are very likely to emerge (Freeman, 2009).

The term stakeholder first appeared in 1963 in an internal memo of the Stanford Research Institute and was originally defined as the groups without whose support a business would cease to exist. Later, the second definition contains all those who influence or are influenced by the achievements and also the goals of a business (Bao& Van Long, 2021).

By expanding the definition of stakeholders, the analysis becomes more complicated, and problems arise when designing the corporate governance system and its strategic implementation. Franks and Mayer identified internal and external stakeholders, answering the question of which stakeholders have the right to demand their participation in management or influence in shaping the company's strategic goals (Miles, 2017).

According to the influence of the interested parties, Franks and Mayer respectively classified the systems of corporate governance. Usually, external systems are identified with the Anglo-Saxon system of corporate governance and internal systems with the continental European system (Parmar et al., 2010).

## 5.5 Other theories

The Stewardship Theory differs significantly from the Agency Theory, mainly in the fact that it recognizes other motivations for the actions of executives, other than financial self-interest. It implies that there is no conflict between the interests of executives - agents and owners - principals and that in order to have a successful organization a structure is required where coordination can be done in a more efficient way (Davis et al., 2018; Keay, 2017).

Managerial Hegemony Theory argues that organizational structures, structures of transfer of authority, control and supervision have essentially weakened or have reduced efficiency and led to the strengthening and hegemony of executives. The lack of motivation for the shareholders to take up duties, as the main stakeholder, leads to the weakening of their strategic participation and the adoption of the strategy of loyalty or exit from the company. Essentially, this is the result of the inadequacy of the relationship of agency and business ethics in enforcing rules that make it easier for other stakeholders and especially shareholders to carry out their duties (Clarke, 2004).

## 5.6 Corporate governance systems

The modern concept of Corporate Governance was strongly influenced by the theory of conflict of interests between owners and managers of a business (Agency Theory). This problem

is due to the fact that in many cases the management of a business for various reasons does not work in the interest of its owners (Carati& Rad, 2000).

These conflicts of interest between the owners and managers of a business have necessitated the establishment of Corporate Governance systems, whose main objective is to ensure a transparent, efficient, and effective management that maximizes the economic value of the business, while protecting the interests of all shareholders and of its creditors (Carney et al., 2011; Osemeke&Adegbite, 2016).

The fact of the existence, inside a company and more generally in the economy, of an effective system of Corporate Governance, helps to create trust, necessary for the protection of investors, i.e. shareholders and creditors, of companies listed on stock exchanges and also for the orderly operation of the market. Consequently, with an effective corporate governance system in place, the cost of capital is lower and companies can allocate their resources more appropriately (Demski, 2003; Dey, 2008; Ingley& Van der Walt, 2004).

Based on research, investors are discouraged from offering capital to companies in countries with weak Corporate Governance systems. In 2000, a survey of 200 institutional investors worldwide showed that more than 75% of institutional investors consider with equal seriousness the corporate governance systems of the companies in which they invest their funds and the corresponding financial results, to shape their investment options. Also, over 80% of institutional investors are willing to pay more for the shares of companies that have strong corporate governance systems compared to companies that have weak investor protection systems (Palaiologos, 2013).

# Chapter 6:

# Game Theoretic Approach

## 6.1 The development of the Game Theory

The first known reference to Game Theory was made in 1838 by the French philosopher and economist Augustin Cournot who analyzed the oligopolistic behaviors of competitive firms in a manner similar to the modern methods of Game Theory (Morrison, 1998). The essential development of Game Theory began in 1920 by the mathematician Emil Borel, but the true birth and name of this theoretic approach is attributed to the Hungarian physicist and mathematician, John von Neumann, who in 1928 proved that zero-sum games always have a solution, since and that one player's loss is equal to the other's gain. He argued that each player, being rational and selfish, will choose to follow that strategy that has the greatest benefit (Forgó, 2004).

A decisive event in the development of game theory was the publication of the book "Theory of Games & Economic Behavior", in 1944, by John von Neumann and Oskar Morgenstern (von Neuman, 1944). In the early 1950s the American mathematical economist John Nash introduced the concept of equilibrium for non-zero-sum games, also known as Nash equilibrium (Nash, 1950). This is a situation that no player in a game has been comfortable moving out of, given the options of the opponents.

In the following decades, Game Theory experienced leaps and bounds and began to be applied in many fields, among them political sciences, while numerous research experiments were started, trying to analyze and provide solutions in the light of Game Theory to more and more problems. In 1965 ReinhardSelten studied dynamic games, which are games that evolve over time, introducing the concept of subgame perfect equilibrium and trembling hand perfect equilibrium, while in 1975 John Harsanyi generalized his ideas John Nash and studied games of incomplete information (Osborne, 2004).

For their work, these three scientists were honored in 1994 with the Nobel Prize of the Swedish Academy of Sciences. In the 1970s, Game Theory was also applied to the field of biology, as a result of John Maynard Smith's work related to the concept of "evolutionary stable strategy"

(Smith, 1979). In the late 1990s, game theory was applied to an even wider range of subjects, such as auction design. Various scientists dealt with this issue for the allocation of rights to use the electromagnetic spectrum in the mobile telecommunications industry.

## 6.2 The fields of application of the Game Theory

Any situation that describes a competitive activity in which players compete against each other according to a set of rules is potentially an application of Game Theory. Game Theory examines decision-making problems in which most decision-makers have to choose between two alternative strategies in order to maximize their utility, that is, they behave rationally (Paravantis, 2016).

Therefore, it is obvious that Game Theory covers a very wide range of applications. These main applications can be categorized into three main fields: everyday life, business and economy, and politics and international relations (Dixit, 2006).

First of all, Games are a very useful tool for analyzing interpersonal relationships in everyday life. Everyday human interactions can be analyzed with the help of Game Theory (Stevens, 2008; Miller, 2003), modeled on four basic Games (i.e. coordination game, chicken game, battle of the sexes, prisoners' dilemma).The specific categories of games, given as examples, will not be further analyzed because their analysis is beyond the scope of this thesis.

Economics and business are one of the first fields of application of Game Theory (Neuman, 1944), a fact demonstrated by the five Nobel Prizes in economics that have been awarded. In addition to the classical analysis of oligopolistic markets and market competition, where firms exhibit competitive behavior in order to increase their market shares, and therefore their profits, Game Theory can also be applied to the opening of new markets (Brandenburger & Nalebuff, 1995), where during market opening it is in the interest of firms to cooperate rather than compete.

Applications in the field of business are also extended to the individual level of executives, by examining strategies for the professional development of executives and negotiations that lead all actors to satisfactory rewards and not necessarily to the detriment of one against the other (Dixit, 2006).

Politics and international diplomacy are other fields in which Game Theory has more recently been applied (Schelling, 1980), but it is flourishing, especially in the field of international relations analysis. Games that analyze international relations are either cooperative games, in

which it is to the benefit of all players and the whole to cooperate, or games, in which there is a social dilemma, the outcome of which is not necessarily the one that has the best outcome both for the players and for the whole (McCain, 2008).

## 6.3 Game Theory and Corporate Governance

Kruitwagen et al. (2017) examine the relationship that prevails between the shareholders of business units and their executives, especially for companies that show high levels of exposure to the prevailing risk stemming from climate change. The researchers, in more detail, carry out parameterization procedures of individual characteristics of business units and shareholders that play a decisive role in making strategic decisions regarding divestment or commitment assignment processes, depending on the levels of risk arising from carbon emissions.

Thus, the researchers end up formulating specific propositions for the existence of determining factors of a psychological nature, but also for the existence of situational determining factors. For example, psychological factors are memory and foresight, while on the other hand, situational factors are the resulting benefit, cost, as well as the size of the investing public.

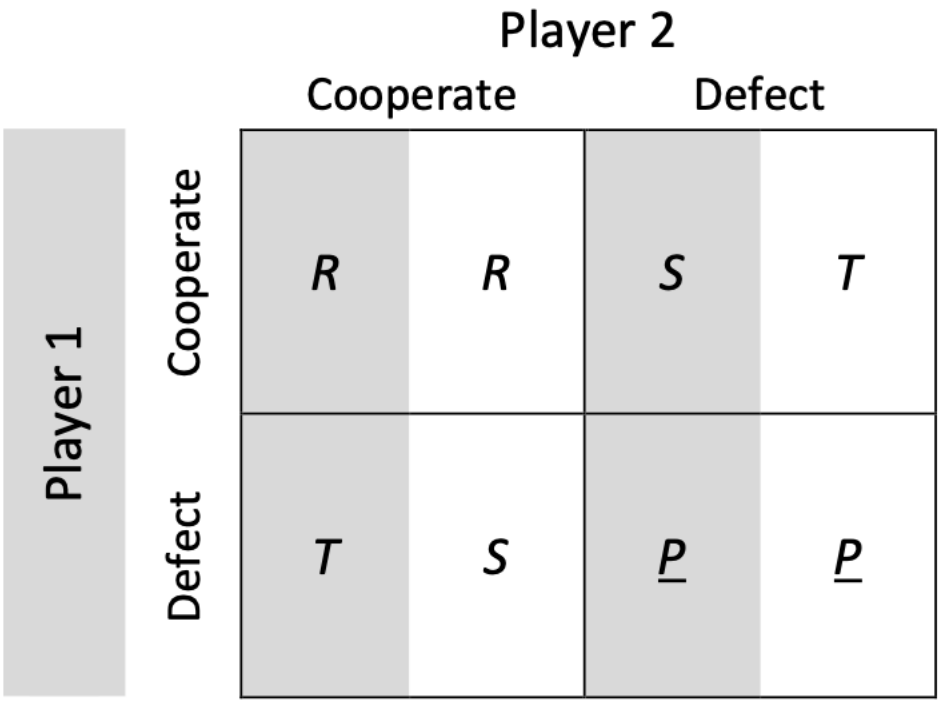
From these determinants it is possible to provide useful information concerning the development management theory, which was developed by Davis et al. (1997) and agency theory, which was analyzed by Ross (1973). According to the researchers, the application of the concepts related to the game theory is done in the interconnection of the shareholders of the companies with their directors. Thus, the development of elementary models occurs, which are useful in investigating the levels of dynamics that the applied engagement strategies have.

The research by Kruitwagen et al. (2017), more specifically, examines how the investment public and business entities can develop interaction, with the goal of reducing the levels of risks brought about by climate change. The main subject of the research is the set of individual processes that lead to decision-making, both on the part of the business units active in the oil and gas sector, as well as their investment public.

Moreover, worth mentioning is the Kruitwagen et al. (2017)'s analysis about the iterative prisoner's dilemma. More specifically, the researchers proceed to develop a repeated prisoners' dilemma of the "1v1" format, in order to represent the interaction that an investor has with a business entity. They point out that a possible outcome of cooperation between investors and companies is one where investors are actively involved in an issue of interest to them, and the corresponding company makes a corresponding change in its attitude and behavior.

Kruitwagen et al. (2017) present the following figure, to identify the prisoners' dilemma's most common form:

**Figure 3:** 1v1 Prisoner's dilemma payoffs in matrix form with Nash Equilibrium underlined




Between other games of the "2x2" form, the description of the prisoner's dilemma is identified by the relationship: T > R > P > S. This leads to "non-cooperative Nash Equilibria", which has the form of "defect - defect" of Figure 2. The "non-cooperative Nash Equilibria" lead to inability for predicting the "cooperative equilibria" between business entities and people.

The variables that are investigated in the model created by Kruitwagen et al. (2017) concern on the one hand the costs and on the other hand the benefits of the cooperation of the participating "agents". Moreover, researchers present the following table, in which they describe the way through which foresight, memory, IPD payoffs and discounts interpret the cooperation between the "agents":

**Table1:** IPD Parameterization of Kruitwagen et al. (2017)

| Parameter | Symbol | Interpretation |
|---|---|---|
| Benefit | $BEN = [1 \dots 10]$ | Benefit of cooperation, e.g. financial outperformance of company, mitigation of asset and reputation risk, talent attraction, social licence to operate |
| Cost | $COS = [0 \dots {}^{BEN}/_{2}]$ | Cost of cooperation, e.g. engagement personnel salaries, opportunity costs, or reluctance, resistance, and laziness |
| IPD Payoffs | Temptation | $T = BEN$ |
| | Reward | $R = BEN - COS$ |
| | Punishment | $P = 0$ |
| | Sucker | $S = -COS$ |
| Discount Factor | $\delta_i = [0\% \dots 100\%]$ | Decreased value of future payoffs relative to present payoffs, or probability of game termination on subsequent round. |
| Memory | $Q_i = [1 \dots 10]$ | Horizon of significance for past activity on which agents base present beliefs |
| Foresight | $L_i = [1 \dots 10]$ | The number of iterations an agent foresees in the future for which they calculate future-value payoffs |

At this point it is mentioned that Kruitwagen et al. (2017) developed an "N-agent IPD", in order for them to represent the agents' coordination. They more specifically mention that these types of models are usually developed for the investigation of "free-riding challenges" and the coordination during the existence of socially defined dilemmas. At the context of their study the NIPD model is used for the investigation of how much the investors are interested in developing coalitions while they are engaged with the business entities. The elements that frame their NIPD model are presented in the following table:

**Table 2:** Elements of NIPD of Kruitwagen et al. (2017)

| | |
|---|---|
| Game | $g = g_i(A, v)$ |
| Players | $i = 1,2, \dots, N$ |
| Action Space | $A_i = [COOPERATE, DEFECT] = [C, D]$ |
| Pure Strategy | $a_i \in A_i$ |
| Pure Strategy Payoffs | $v_i = f(a_i, k)$ |

More analytically, Kruitwagen et al. (2017) mention that "agents" that are involved in a specific "game" have to choose between either defecting or cooperating, while at the NIPD model the choice of cooperation is more developed in the games to which higher number of agents participate. For the same amount of cooperating agents, the agents that choose defection have the advantage of receiving higher payoff levels.

In the context of the application of this particular methodology, the researchers conclude that during social dilemmas, there is an excess of the costs against the possible benefits, in terms

of the development of partnerships. More specifically, it is pointed out that company executives, as they prepare for a commitment to the risk of climate change, are willing to reduce their expenditure levels at the time of this commitment. Thus, the chances of collaborations increase.On the other hand, the investing public ends up demanding gradual progress, which ends up being beneficial for company executives as well. Thus, cooperative equilibria are dominated by cost. This is also why the passive investing public, which includes people operating within strict business models, does not show high levels of willingness to participate in management efforts (Kruitwagen et al., 2017).

Also, in the context of the NIPD model developed by Kruitwagen et al. (2017), it is shown that the long-term memory of the players leads to a decrease in the probability of cooperative equilibrium. For example, facts of past miscarriages can have a negative influence on cooperative efforts in the present. Then, the investing public should look for small and consistent points of improvement on the part of corporate executives over a number of years, rather than their rapid and transient changes and adjustments.

Conversely, a failure to cooperate result is one where the company or the investing public refuses to fulfill their mutual obligations. Thus, investors may end up losing interest in the particular issue, or even withdraw their investment from the particular business unit (Kruitwagen et al., 2017).

A key feature of the iterative prisoner's dilemma is that the rewards resulting from mutual cooperation between the two parties do not expire over time. At the same time, however, the parties are faced with temptations to breach their commitments and in the event that such breach occurs then we end up with non-cooperative outcomes (Kruitwagen et al., 2017).

Also, the subject of this research is the determination of how the decisions made by the companies and their investors influence each other. In fact, it is clarified that the study of how individuals and companies make decisions falls within the framework of decision theory. Decision theory studies how rationally thinking individuals are led to maximize their desired outcomes, especially when they are under uncertain conditions (Hansson, 1994).

Decision theory stems from the basis of the Theory of Expected Utility, which was developed by Daniel Bernoulli in the year 1738.The study of Mesterton - Gibbons (2000) presents the individual domains of decision theory, according to the number of agents and the number of rewards given to them. For better understanding, it is expressed as below:

**Figure 3:** Number of agents and rewards

| Number of agents | Number of rewards: r=1 | Number of rewards: r>1 |
|---|---|---|
| n=1 | Scalar Optimization Problems<br>e.g. Mathematical optimization | Vector Optimization Problems<br>e.g. Multi-Criteria Decision Making (MCDM) |
| n>1 | Game Theory | Vector Game Theory<br>e.g. Vector-Valued MCDM |

At this point, it is clarified that when the decisions made by the investing public are inextricably linked to the corresponding decisions made by business entities, game theory is used by Kruitwagen et al. (2017), in order for them to investigate the decision-making process involving different actors.

The use of game theory, more specifically, is done in order to find solutions to achieve equilibrium. In fact, the aim is that there is no deviation of any "player" from the proposed solutions in question. At this point, the presence of many different concepts that reflect the intended state of balance is clarified.

These concepts, in fact, are different from each other in terms of the way in which they treat rationality, in terms of the levels of robustness they have for the different views espoused by the "agents" involved, as well as in terms of the levels at which are held constant in case the game can be repeated (Madani & Hipel, 2011).

In the study by Kruitwagen et al. (2017), non-cooperative games, which fall into the field of social dilemmas, were exploited in order to develop the conditions for the effective management of business units by their investment public. Also, the repeated dilemmas of the prisoners were exploited, in order to investigate the conditions of mutual cooperation by two or more involved agents.

The games and the insights derived from them were further informed by conducting semi-structured interviews with energy and finance industry professionals, as well as professionals working in non-profit organizations, various regulatory agencies, and academia.

Kruitwagen et al. (2017) found numerous barriers that interfere with mutual cooperation on the commitments that investors and companies have. One of these obstacles, for example, is the disproportionate levels of costs incurred in relation to the benefits, as well as low discount rates, short-term perspectives, and increased levels of sensitivity to past memories.

Also, an increase in the number of "free temptations" was found in cases where there are groups with more agent members. This makes it even more difficult to create partnerships between groups with a large number of stakeholders. The development of stable partnerships between investors, however, can be achieved if innovative solutions are implemented, which are proposed by Kruitwagen et al. (2017).

Characteristic examples of such solutions are the adoption of lateral payment mechanisms, as well as the development of social networks. Such solutions can contribute to the cultivation of stable structures in order to develop strong partnerships between investors.

The long-term interests of the shareholders of the companies, in fact, are the driving forces of the performance levels of their investments. The reason is that efforts are being made by them to mitigate the levels at which they are exposed to risks. For the investing public interested in influencing the behavior of business entities, however, challenges continue to exist to address the short-term disconnect between corporate executives and investors.

In fact, Kruitwagen et al. (2017) point out that investors who aim to create stable partnerships with other investors, it is imperative that they are not bound and not influenced by the “free incentives” that exist. In this way they will be able to influence companies to an even greater extent.

In conclusion, making the decisions to commit and divest is an empirical process. It is a process in which the existing risks must also be considered, which are directly intertwined on the one hand with the environment and on the other with the effectiveness of the engagement of the investing public.

# Chapter 7:

# Conclusion

For businesses, bankers, and institutional investors, climate risk is a problem that is becoming more and more significant. An estimated 1.0°C of global warming has been caused by human activity since preindustrial times. According to the IPCC report from 2018, global warming will likely reach 1.5°C between 2030 and 2052 and 2 to 4°C by the end of the century if it keeps growing at the same rate, leading to an increase in the frequency of extremely hot days, heavy rainfalls, droughts, precipitation deficits, and sea level rise.

Although scientists have long raised the issue, it has just recently come to the attention of the financial sector, despite its importance for the planet's future. Physical hazards and transition risks are the two main categories into which climate change-related risks may be separated. Natural catastrophes associated with climate change, like as hurricanes, storms, or floods, can result in physical hazards by damaging assets and upsetting supply chains.

Acute physical hazards are what are referred to be event-driven risks. In contrast, physical dangers might be long-term, alluding to long-term changes in climate, such rising temperatures or sea levels. Legal risks (climate-related lawsuits), technological risks (new green technologies may disrupt some of a company's operations), market risks (consumers are switching to green products, changing their purchasing habits), and reputational risks are all associated with the process of transitioning to a lower-carbon economy.

Due to financial savings, access to new markets, and the creation of new goods, climate change may also present businesses with new opportunities. As noted by Diaz-Rainey et al. (2017), until 2015 there were hardly any publications on the subject in the major finance journals, although there were some precursors. There have also been a large number of papers on corporate social responsibility and in the field of economy that assess the economic effects of climate changes.

The likelihood, size, and timing of climate risk's consequences on the financial system are uncertain and difficult to predict. Only a few of the factors that connect climate change to finance include climate change legislation, advancements in climate finance, technological progress, green

investment, weather occurrences, long-term physical impacts, and reporting systems. The risk presented by climate change has been described as extreme, continuing, extremely uncertain, and hazardous.

The narrative surrounding climate science and its consequences is gaining popularity over time. However, more work has to be done to increase awareness of climate change and how it impacts financial institutions. This research looked at the financial ramifications of the climate threats that different stakeholders face. The hazards associated with the climate that have been examined include three: liability risks, transition risks, and physical risks. Physical hazards are described as sudden and recurring occurrences brought on by climate change that can seriously harm economic activity. The main concern is on the board members' potential future actions, which might have an impact on not just the economy's stability but also on people's welfare state.

# Bibliography


Abdullah, H., & Valentine, B. (2009). Fundamental and ethics theories of corporate governance. Middle Eastern Finance and Economics, 4(4), 88-96.

Aghion, P., Dechezleprêtre, A., Hemous, D., Martin, R., & Van Reenen, J. (2016). Carbon taxes, path dependency, and directed technical change: Evidence from the auto industry. Journal of Political Economy, 124(1), 1-51.

Agrawal, A. K. (2012). Corporate governance objectives of labor union shareholders: Evidence from proxy voting. The Review of Financial Studies, 25(1), 187-226.

Åhman, M., Nilsson, L. J., & Johansson, B. (2017). Global climate policy and deep decarbonization of energy-intensive industries. Climate Policy, 17(5), 634-649.

Alabdullah, T. (2014). Corporate governance development: New or old concept. Corporate Governance, 6(7).

Alok, S., Kumar, N., & Wermers, R. (2020). Do fund managers misestimate climatic disaster risk. The Review of Financial Studies, 33(3), 1146-1183.

Andersson, M., Bolton, P., & Samama, F. (2016). Governance and climate change: A Success story in mobilizing investor support for corporate responses to climate change. Journal of Applied Corporate Finance, 28(2), 29-33.

Aragón-Correa, J. A., & Sharma, S. (2003). A contingent resource-based view of proactive corporate environmental strategy. Academy of management review, 28(1), 71-88.

Bansal, P., Gao, J., & Qureshi, I. (2014). The extensiveness of corporate social and environmental commitment across firms over time. Organization Studies, 35(7), 949-966.

Bansal, R., Kiku, D., & Ochoa, M. (2016). Price of long-run temperature shifts in capital markets (No. w22529). National Bureau of Economic Research. Available at: https://www.nber.org/system/files/working_papers/w22529/w22529.pdf

Bao, V. N., & Van Long, T. (2021). Applying the stakeholder theory to analyze the state-owned enterprise management in Vietnam: From enterprise law to company charter and beyond. International Journal of Entrepreneurship, 25, 1-11.

Batten, S., Sowerbutts, R., & Tanaka, M. (2016). Let's talk about the weather: the impact of climate change on central banks.Bank of England Working Paper No. 603.

Bendickson, J., Muldoon, J., Liguori, E. W., & Davis, P. E. (2016). Agency theory: background and epistemology. Journal of Management History, 22(4).

Berkman, H., Jona, J., Lee, G., &Soderstrom, N. (2018). Cybersecurity awareness and market valuations. Journal of Accounting and Public Policy, 37(6), 508-526.

Bernstein, A., Gustafson, M. T., & Lewis, R. (2019). Disaster on the horizon: The price effect of sea level rise. Journal of financial economics, 134(2), 253-272.

Berrone, P., & Gomez-Mejia, L. R. (2009). The pros and cons of rewarding social responsibility at the top. Human Resource Management, 48(6), 959-971.

Bolton, P., &Kacperczyk, M. T. (2020). Carbon premium around the world. Available at: https://www.hec.ca/finance/Fichier/Kacperczyk2020.pdf

Brandenburger, A. M., & Nalebuff, B. J. (1995). The right game: Use game theory to shape strategy. Chicago: Harvard Business Review.
Broker, T., Durr, D., & Smith, M. (2019). Analysis of the global energy industry, climate change and financial matters: the need for effective corporate governance. International Journal of Corporate Governance, 10(3-4).
Bruno, S. (2019). Climate Corporate Governance: Europe vs. USA?. European Company and Financial Law Review, 16(6), 687-723.
Carati, G., & Rad, A. T. (2000). Convergence of corporate governance systems. Managerial Finance, 26(10).
Carney, M., Gedajlovic, E., & Sur, S. (2011). Corporate governance and stakeholder conflict. Journal of Management & Governance, 15(3), 483-507.
Choi, D., Gao, Z., & Jiang, W. (2020). Attention to global warming. The Review of Financial Studies, 33(3), 1112-1145.
Choua, P. H., &Tsengb, J. J. (2015). Environmental management and environmental investment: Considering the effect of board governance. WCBM 2015.
Claessens, S. (2006). Corporate governance and development. The World bank research observer, 21(1), 91-122.
Clapp, C., Lund, H. F., Aamaas, B., & Lannoo, E. (2017). Shades of Climate Risk. Categorizing climate risk for investors. CICERO Report. Available at: https://pub.cicero.oslo.no/cicero-xmlui/bitstream/handle/11250/2430660/Shades%20of%20Climate%20Risk%20nyformatting%20(Sistetil%20web13%2002%202016).pdf?sequence=1&isAllowed=y
Clarke, T. (1998). Research on corporate governance. Corporate Governance, 6(1), 57-66.
Clarke, T. (2004). Theories of corporate governance. The Philosophical Foundations of Corporate Governance, Oxon, 12(4), 244-266.
Cogan, D. G. (2006). Corporate governance and climate change: Making the connection. Available at: http://ww.w.rrojasdatabank.info/ceres06.pdf
Cotter, J., & Najah, M. M. (2012). Institutional investor influence on global climate change disclosure practices. Australian journal of management, 37(2), 169-187.
Daft, R. L., & Lewin, A. Y. (1990). Can organization studies begin to break out of the normal science straitjacket? An editorial essay. Organization Science, 1(1), 1-9
Davis, J. H., Schoorman, F. D., & Donaldson, L. (1997). Davis, Schoorman, and Donaldson reply: The distinctiveness of agency theory and stewardship theory. Academy of Management. the Academy of Management Review, 22(3), 611.
Davis, J. H., Schoorman, F. D., & Donaldson, L. (2018). Toward a stewardship theory of management. In Business ethics and strategy. London: Routledge.
Davis, J., Schoorman, K., &Donaldson, L. (1997). Towards a Stewardship Theory ofManagement. The Academy of Management Review, 22(1), 20–47.
Dawkins, C., &Fraas, J. W. (2011). Coming clean: The impact of environmental performance and visibility on corporate climate change disclosure. Journal of business ethics, 100(2), 303-322.
Delis, M. D., De Greiff, K., &Ongena, S. (2019). Being stranded with fossil fuel reserves? Climate policy risk and the pricing of bank loans. Climate Policy Risk and the Pricing of Bank loans (September 10, 2019). EBRD Working Paper, (231).
Deloitte. (2009). Acting as one in a changing world – Sustainability Report. Available at: https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/about-deloitte/deloitte-nl-sustainability-report-2009_2010.pdf

Demski, J. S. (2003). Corporate conflicts of interest. Journal of Economic Perspectives, 17(2), 51-72.
Deryugina, T., & Hsiang, S. M. (2014). Does the environment still matter? Daily temperature and income in the United States (No. w20750). National Bureau of Economic Research.
Dessaint, O., & Matray, A. (2017). Do managers overreact to salient risks? Evidence from hurricane strikes. Journal of Financial Economics, 126(1), 97-121.
Dey, A. (2008). Corporate governance and agency conflicts. Journal of accounting research, 46(5), 1143-1181.
Dietz, S., & Hope, C. (2007). Reflections on the Stern Review. World Economics, 8(1), 121-168.
Dixit, A. (2006). Thomas Schelling's contributions to game theory. The Scandinavian Journal of Economics, 108(2), 213-229.
Du Plessis, J. J., Hargovan, A., & Harris, J. (2018). Principles of contemporary corporate governance. Cambridge: Cambridge University Press.
Dyck, A., Lins, K. V., Roth, L., & Wagner, H. F. (2019). Do institutional investors drive corporate social responsibility? International evidence. Journal of Financial Economics, 131(3), 693-714.
Fang, K., Zhang, Q., Ye, R., & Zhou, Y. (2018). Allocating China's carbon emission allowance to the provincial quotas in the context of the Paris Agreement. Acta Scientiae Circumstantiae, 38(3), 1224-1234.
Fankhauser, S., &Tol, R. S. (2005). On climate change and economic growth. Resource and Energy Economics, 27(1), 1-17.
Finegold, D., Benson, G. S., & Hecht, D. (2007). Corporate boards and company performance: Review of research in light of recent reforms. Corporate Governance: an international review, 15(5), 865-878.
Forgó, F. (2004). John Von Neumann's contribution to modern game theory. ActaOeconomica, 54(1), 73-84.
Freeman, R. E. (2009). Stakeholder theory: 25 years later. Philosophy of Management, 8(3), 97-107.
Friedman, M. (1970). A theoretical framework for monetary analysis. journal of Political Economy, 78(2), 193-238.
Friese, A., Link, S., & Mayer, S. (2008). Taxation and corporate governance—The state of the art. Tax and corporate governance, 357-425.
Galbreath, J. (2010). Corporate governance practices that address climate change: An exploratory study. Business Strategy and the Environment, 19(5), 335-350.
Ginglinger, E., & Moreau, Q. (2019). Climate risk and capital structure. Université Paris-Dauphine Research Paper, (3327185).
Gözlügöl, A. A. (2022). The clash of 'E' and 'S' of ESG: just transition on the path to net zero and the implications for sustainable corporate governance and finance. The Journal of World Energy Law & Business, 15(1), 1-21.
Graves, S. B., &Waddock, S. A. (1994). Institutional owners and corporate social performance. Academy of Management journal, 37(4), 1034-1046.
Griffin, P., Lont, D., & Lubberink, M. (2019). Extreme high surface temperature events and equity-related physical climate risk. Weather and Climate Extremes, 26, 100220.
Guterres, A. (2019). Progress toward sustainable development is seriously off-track. Financial Times, 4.

Hansson, S. O. (1994). Decision theory. A brief introduction. Department of Philosophy and the History of technology. Stockholm: Royal Institute of Technology.
Haque, S., & Deegan, C. (2010). Corporate climate change-related governance practices and related disclosures: evidence from Australia. Australian accounting review, 20(4), 317-333.
Haque, S., Deegan, C., & Inglis, R. (2016). Demand for, and impediments to, thedisclosure of information about climate change-related corporate governance practices. Accounting and Business Research, 46(6), 620-664.
Harman, W., & Porter, M.(1997). The new business of business: Sharing responsibility for a positive global future. London: Berrett-Koehler Publishers.
Hendry, K., & Kiel, G. C. (2004). The role of the board in firm strategy: Integrating agency and organisational control perspectives. Corporate Governance: An International Review, 12(4), 500-520.
Hilb, M. (2008). New corporate governance. Berlin: Springer.
Hoffman, A. J. (2007). Carbon strategies: How leading companies are reducing their climate change footprint. Michigan: University of Michigan Press.
Hong, H., Li, F. W., & Xu, J. (2019). Climate risks and market efficiency. Journal of econometrics, 208(1), 265-281.
Hugon, A., & Law, K. (2019). Impact of climate change on firm earnings: evidence from temperature anomalies. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3271386
Ingley, C. B., & Van der Walt, N. T. (2004). Corporate governance, institutional investors and conflicts of interest. Corporate Governance: an international review, 12(4), 534-551.
IPCC. (2014). AR5 Climate Change 2014: Mitigation of Climate Change. Available at: https://www.ipcc.ch/report/ar5/wg3/
John, K., De Masi, S., & Paci, A. (2016). Corporate governance in banks. Corporate Governance: An International Review, 24(3), 303-321.
Johnson, R. A., & Greening, D. W. (1999). The effects of corporate governance and institutional ownership types on corporate social performance. Academy of management journal, 42(5), 564-576.
Keay, A. (2017). Stewardship theory: is board accountability necessary?. International Journal of Law and Management, 59(6).
Khan, H. (2011). A literature review of corporate governance. International Conference on E-business, management and Economics, 25(1), 1-5.
Kiel, G. C., & Nicholson, G. J. (2005). Evaluating boards and directors. Corporate Governance: An International Review, 13(5), 613-631.
Kolk, A., & Pinkse, J. (2005). Business responses to climate change: identifying emergent strategies. California Management Review, 47(3), 6-20.
Kolk, A., & Pinkse, J. (2007). Towards strategic stakeholder management? Integrating perspectives on sustainability challenges such as corporate responses to climate change. Corporate Governance: The international journal of business in society.
Kolk, A., & Pinkse, J. (2008). Business and climate change: emergent institutions in global governance. Corporate Governance: The international journal of business in society.
Kolk, A., Levy, D., & Pinkse, J. (2008). Corporate responses in an emerging climate regime: The institutionalization and commensuration of carbon disclosure. European accounting review, 17(4), 719-745.

Krueger, P., Sautner, Z., & Starks, L. T. (2020). The importance of climate risks for institutional investors. The Review of Financial Studies, 33(3), 1067-1111.

Kruitwagen, L., Madani, K., Caldecott, B., & Workman, M. H. (2017). Game theory and corporate governance: conditions for effective stewardship of companies exposed to climate change risks. Journal of Sustainable Finance & Investment, 7(1), 14-36.

Kruitwagen, L., Madani, K., Caldecott, B., & Workman, M. H. (2017). Game theory and corporate governance: conditions for effective stewardship of companies exposed to climate change risks. Journal of Sustainable Finance & Investment, 7(1), 14-36.

Lemphers, N. C. (2020). Beyond the Carbon Curse: a Study of the Governance Foundations of Climate Change Politics in Australia, Canada and Norway. Doctoral dissertation. Canada: University of Toronto.

Llewellyn, J. (2007). The business of climate change: challenges and opportunities. London: Lehman Brothers.

Lujala, P., Lein, H., & Rød, J. K. (2015). Climate change, natural hazards, and risk perception: the role of proximity and personal experience. Local Environment, 20(4), 489-509.

Luo, Y. (2005). Corporate governance and accountability in multinational enterprises: Concepts and agenda. Journal of international management, 11(1), 1-18.

Madani, K., & Hipel, K.(2011). Non-Cooperative Stability Definitions for Strategic Analysis of Generic Water Resources Conflicts. Water Resources Management, 25(8), 1949–1977.

Manabe, S. (2019). Role of greenhouse gas in climate change. Tellus A: Dynamic Meteorology and Oceanography, 71(1), 1620078.

Margolis, J. D., & Walsh, J. P. (2003). Misery loves companies: Rethinking social initiatives by business. Administrative science quarterly, 48(2), 268-305.

Matten, D., & Crane, A. (2005). Corporate citizenship: Toward an extended theoretical conceptualization. Academy of Management review, 30(1), 166-179.

McCain, R. A. (2008). Cooperative games and cooperative organizations. The Journal of Socio-Economics, 37(6), 2155-2167.

Mesterton-Gibbons, M. (2000). An Introduction to Game-Theoretic Modelling. USA: American Mathematical Society.

Mielke, J., &Steudle, G. A. (2018). Green investment and coordination failure: an investors' perspective. Ecological Economics, 150, 88-95.

Miles, S. (2017). Stakeholder theory classification: A theoretical and empirical evaluation of definitions. Journal of Business Ethics, 142(3), 437-459.

Miller, J. D. (2003). Game theory at work: how to use game theory to outthink and outmaneuver your competition. New York: McGraw-Hill.

Morrison, C. C. (1998). Cournot, Bertrand, and modern game theory. Atlantic Economic Journal, 26(2), 172-174.

Nash, J. F. (1950). Equilibrium points in n-person games. Proceedings of the national academy of sciences, 36(1), 48-49.

Neubaum, D. O., & Zahra, S. A. (2006). Institutional ownership and corporate social performance: The moderating effects of investment horizon, activism, and coordination. Journal of Management, 32(1), 108-131.

Neuman, J. V. (1944). Theory of games and economic behaviour. Princeton: Princeton University Press, 19, 14.

OECD, O. (2004). The OECD principles of corporate governance. Contaduría y Administración, (216).

Osborne, M. J. (2004). An introduction to game theory. New York: Oxford university press.
Osemeke, L., &Adegbite, E. (2016). Regulatory multiplicity and conflict: Towards a combined code on corporate governance in Nigeria. Journal of business ethics, 133(3), 431-451.
Painter, M. (2020). An inconvenient cost: The effects of climate change on municipal bonds. Journal of Financial Economics, 135(2), 468-482.
Paleologos, A. (2013). Corporate Governance and corporate social responsibility in listed companies of the Athens Stock Exchange. Available at: http://mibes.teithessaly.gr/esdo_proceedings/proceedings/2013/Palaiologos.pdf
Panda, B., &Leepsa, N. M. (2017). Agency theory: Review of theory and evidence on problems and perspectives. Indian Journal of Corporate Governance, 10(1), 74-95.
Paravantis, J. A. (2016). From game theory to complexity, emergence and agent-based modeling in world politics. Berlin: Springer.
Parmar, B. L., Freeman, R. E., Harrison, J. S., Wicks, A. C., Purnell, L., & De Colle, S. (2010). Stakeholder theory: The state of the art. Academy of Management Annals, 4(1), 403-445.
Peker, K., Kan, M., & Nadeem, M. (2019). Corporate governance of climate change adaptation. J. Glob. Innov. Agric. Soc. Sci, 7(1), 1-5.
Pindyck, R. S. (2013). Climate change policy: what do the models tell us?. Journal of Economic Literature, 51(3), 860-72.
Ritz, R. (2020). Climate targets, executive compensation, and corporate strategy (No. EPRG2029).
Ross, S. (1973). The Economic Theory of Agency: The Principal's Problem. The AmericanEconomic Review, 63(2), 134–139.
Saam, N. J. (2007). Asymmetry in information versus asymmetry in power: Implicit assumptions of agency theory? The Journal of Socio-Economics, 36(6), 825-840.
Schelling, T. C. (1980). The Strategy of Conflict: with a new Preface by the Author. Harvard: Harvard university press.
Segrestin, B., & Hatchuel, A. (2011). Beyond agency theory, a post-crisis view of corporate law. British Journal of Management, 22(3), 484-499.
Seltzer, L. H., Starks, L., & Zhu, Q. (2022). Climate regulatory risk and corporate bonds (No. w29994). National Bureau of Economic Research.
Smith, J. A., Morreale, M., & Mariani, M. E. (2008). Climate change disclosure: Moving towards a brave new world. Capital markets law journal, 3(4), 469-485.
Smith, J. M. (1979). Game theory and the evolution of behaviour. Proceedings of the Royal Society of London. Series B. Biological Sciences, 205(1161), 475-488.
Stern, N. (2013). The structure of economic modeling of the potential impacts of climate change: grafting gross underestimation of risk onto already narrow science models. Journal of Economic Literature, 51(3), 838-59.
Stevens, S. P. (2008). Games people play: Game theory in life, business, and beyond. NY: Teaching Company.
Sullivan, R., &Gouldson, A. (2017). The governance of corporate responses to climate change: An international comparison. Business Strategy and the Environment, 26(4), 413-425.
UNFCCC. (2015). The Paros agreement. Available at: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement
United Nations. (2016). Secretary-General's remarks to the press at COP22. Available at: https://www.un.org/sustainabledevelopment/blog/2016/11/secretary-generals-remarks-to-the-press-at-cop22/

Van der Woerd, K. F., de Wit, C. M., Kolk, A., Levy, D. L., &Vellinga, P. (2004). Diverging business strategies towards climate change: a USA-Europe comparison for four sectors of industry. Available at: https://research.vu.nl/ws/files/73707651/ivmvu0749

Velayutham, E. (2014). Voluntary disclosure of greenhouse gas emissions, corporate governance and earnings management: Australian evidence (Doctoral dissertation, University of Southern Queensland).

Vener, J., Fransen, T., Levin, K., Baumwoll, J., Elliott, C., & Ross, K. (2019). Scaling up ambition: leveraging nationally determined contributions and long-term strategies to achieve the Paris agreement goals. Available at: https://files.wri.org/d8/s3fs-public/scaling-up-ambition.pdf

Von Schickfus, M. T. (2021). Institutional investors, climate policy risk, and directed innovation (No. 356). ifo Working Paper.

Walls, J. L., Berrone, P., &Phan, P. H. (2012). Corporate governance and environmental performance: Is there really a link? Strategic management journal, 33(8), 885-913.

Wieland, J. (2005). Corporate governance, values management, and standards: a European perspective. Business & Society, 44(1), 74-93.

Worsham, J., Eisner, M. A., &Ringquist, E. J. (1997). Assessing the assumptions: A critical analysis of agency theory. Administration & Society, 28(4), 419-440.

Wright, P., Mukherji, A., & Kroll, M. J. (2001). A reexamination of agency theory assumptions: extensions and extrapolations. The Journal of Socio-Economics, 30(5), 413-429.