UNIVERSIDAD DE ALMERÍA

TESIS DOCTORAL

DOES CSR MANAGEMENT INFLUENCE CORPORATE FINANCIAL PERFORMANCE? UNDERSTANDING THE EFFECTS OF ESG FACTORS ON THE OIL AND GAS INDUSTRY IN THE CONTEXT OF THE ENERGY TRANSITION

TESIS PRESENTADA POR

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PROGRAMA DE DOCTORADO EN CIENCIAS ECONÓMICAS, EMPRESARIALES Y JURÍDICAS

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¿INFLUYE LA GESTIÓN DE LA RSC EN EL COMPORTAMIENTO FINANCIERO CORPORATIVO? ENTENDIENDO LOS EFECTOS DE LOS FACTORES ASG EN LA INDUSTRIA DEL PETRÓLEO Y EL GAS EN EL CONTEXTO DE LA TRANSICIÓN ENERGÉTICA

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ABSTRACT

The current situation of climate crisis is a challenge that is becoming increasingly importance for our planet. The continuous affirmations by governments and supranational organizations such as the United Nations warn that this issue must become the focus of global attention during this century. Some of the limits of the Earth have already been exceeded to such an extent that we will never know our planet as we know it today. Many issues contribute to the current climate emergency. However, one of the most important is the CO_2 emission and the high negative impact that the energy industry (mainly the oil and gas industry) has on the environment. The thesis considers it appropriate to focus on this industry for two main reasons, (1) because oil and gas (O&G) are the two most consumed energy sources on our planet and contribute most to CO_2 emissions (along with the coal industry) and thus, the firms working in this industry have an important social and environmental responsibility and, (2) because O&G companies should be the leading exponents in the energy transition towards sustainable energies that reduce the negative impact on the environment which, in turn, affect their performance.

This thesis is framed in the necessary global energy transition. This must be carried out imminently if we want to keep our planet as we know it. However, this transition requires a significant effort to change the economic activity of O&G companies. A change in these characteristics greatly affects the financial performance of companies committed to reducing their impact on the environment and society and start modifying their activity towards exploiting fewer polluting energies. Therefore, companies need to know the impact of improving their Corporate Social Responsibility (CSR) on Corporate Financial Performance (CFP). These two related aspects constitutes the core of this thesis. To understand this relationship, the methodology focuses on a statistical approach based on modeling structural equations by partial least squares (PLS – SEM). Thanks to this technique, we will be able to know what the relationship exists between the CSR strategy (measured by the Environmental, Social and Governance factors) and the CFP (based on a market value approach) for the O&G industry globally. Once this relationship has been tested, it is needed knowing the acceptance of the energy transition by the global investors. With this aim we carry out a comparative analysis of the risk – return ratio for a set of traditional, sustainable, and renewable energy international stock market indices.

The results show that the O&G industry should focus on improving its CSR strategy. In both Chapter II and Chapter III, the relationship between ESG factors and CFP is positive and significant. Specifically, an increase in environmental (E) and social (S) factors leads to an increase in the company's value, so carrying out sustainable policies at an environmental and social level will improve financial performance. Chapter III even highlight how there is a negative moderating effect of ESG Controversies (ESGC) on the relationship between ESG factors and CFP. This tells us that companies must reduce their negative impact on the environment and social level if they want to have a positive effect between the CSR strategy and financial performance. Finally, Chapter IV states that the risk – return ratio in alternative and sustainable energy indices is less attractive at the investors level than traditional indices.

The thesis findings contribute to (1) a more detailed understanding of the effect of CSR on the financial performance of the O&G industry giving advice about to manage energy transition and (2) to understand that energy transition in its current state is not yet attractive enough for financial investors according with the risk-return relationship. The conclusion of these results will allow investors, entrepreneurs, and policymakers to focus on increasing the investment attractiveness for a financially profitable energy transition.

RESUMEN

La situación actual de crisis climática es un desafío que cada vez cobra mayor importancia para nuestro planeta. Las continuas afirmaciones por parte de gobiernos y organismos supranacionales como la Organización de las Naciones Unidas advierten de que esta cuestión se debe convertir en el foco de atención mundial durante este siglo. Algunos de los límites de la Tierra ya han sido sobrepasados, hasta tal punto de que no volveremos a conocer a nuestro planeta tal y como lo conocemos en la actualidad. Muchas cuestiones contribuyen a la situación de emergencia climática actual, si bien una de las más importantes es la emisión de CO_2 y el alto impacto negativo que tiene la industria energética (principalmente la industria del petróleo y el gas) sobre el medioambiente. Esta tesis considera oportuno centrarse en esta industria por dos cuestiones principales, (1) por ser el petróleo y el gas las dos fuentes de energía más consumidas en nuestro planeta y que más contribuyen a las emisiones de CO_2 (junto con la industria del carbón), por lo tanto, las empresas que trabajan en esta industria tienen una importante responsabilidad social y ambiental y, (2) porque las compañías de petróleo y gas deben de ser los exponentes principales en la transición energética hacia energías sostenibles que permitan reducir el impacto negativo sobre el medio ambiente, lo que a su vez afecta a su desempeño económico – financiero.

Esta tesis doctoral se encuentra enmarcada en dicha transición energética. Esta debe de llevarse a cabo de forma inminente si queremos mantener a nuestro planeta tal y como lo conocemos. No obstante, esta transición requiere de un esfuerzo muy importante de cambio en cuanto a la actividad económica de las empresas petroleras y gasísticas. Un cambio de estas características afecta sobremanera al rendimiento económico de las empresas que apuestan por reducir su impacto en el medioambiente y en la sociedad, y comienzan a modificar su actividad para adaptarse a la explotación de energías menos contaminantes. Por lo tanto, las compañías necesitan saber cuál es el impacto que tiene mejorar su Responsabilidad Social Corporativa (RSC) sobre el Comportamiento Financiero Corporativo (CFC). Estos aspectos relacionados constituyen el núcleo de esta tesis. Para conocer esta relación, la metodología empleada se centra en un enfoque estadístico basado en la modelización de ecuaciones estructurales por mínimos cuadrados parciales. Gracias a esta técnica, podremos conocer cuál es la relación entre la estrategia de RSC (medida por los factores *Environmental*, *Social* y *Governance*) y el CFC (medido a través de un enfoque basado en el valor de

mercado) para la industria del petróleo y gas a nivel global. Una vez probada esta relación, es necesario conocer la aceptación de la transición energética por parte de los inversores globales. Con este objetivo llevamos a cabo un análisis comparativo de la relación riesgo – rentabilidad para un conjunto de índices bursátiles internacionales tradicionales, sostenibles y renovables.

Los resultados muestran que la industria del petróleo y el gas debe de poner el foco de atención en mejorar su estrategia de RSC. Tanto en el Capítulo II como en el Capítulo III, la relación entre los factores ESG y el CFC es positiva y significativa. Concretamente, un aumento en los factores medioambiental (E) y social (S) conllevan un aumento del valor de las compañías, por lo que llevar a cabo políticas sostenibles a nivel medioambiental y social permitirá mejorar el desempeño financiero. El Capítulo III incluso pone de relieve la existencia de un efecto moderador negativo de las controversias ESG sobre la relación entre los factores ESG y el CFC. Esto nos indica que las compañías deben de reducir su impacto negativo a nivel medioambiental y social si quieren que se produzca un efecto positivo entre la estrategia de RSC y el desempeño económico – financiero. Finalmente, el Capítulo IV establece que la relación rentabilidad – riesgo en los índices de energía alternativa y sostenible es menos atractiva a nivel inversores que los índices tradicionales.

Los hallazgos de la tesis contribuyen a (1) una comprensión más detallada del efecto de la RSC sobre el desempeño financiero de la industria del petróleo y gas, brindando sugerencias sobre cómo administrar la transición energética y, (2) comprender que la transición energética, en su estado actual, todavía no tiene suficiente atractivo respecto de la relación rentabilidad – riesgo. La conclusión de estos resultados ayudará a inversores, empresarios y políticos a poner el foco de atención en aumentar el atractivo inversor para una transición energética rentable a nivel económico – financiero.

CHAPTER I. INTRODUCTION

1. Introduction

1.1 CSR management and its impact on the O&G industry

The Oil and Gas (hereinafter, O&G) industry generates a high negative impact at the social and environmental level (Ji et al., 2021; Short et al., 2015). According to the Publications Office of the European Union (2021), O&G continue to be the main source of energy on our planet. Specifically, 56% of the total energy consumed globally comes from O&G and their derivatives (British Petroleum, 2021). Moreover, according to the International Energy Agency (2021), 62% of CO_2 emissions come from this energy source, making it one of the largest contributors to climate change. The negative impact is not only environmental, but also social. The recent war in Ukraine and Europe's energy dependence on natural gas from Russia is a recent example (Shagina, 2022). Due to the damage caused by this industry for our planet, Corporate Social Responsibility (hereinafter, CSR) becomes even more important than in other industries with less impact (Khodaparast, 2022). The efficient use of resources or the reduction in CO_2 emissions are some of keyways to reduce the negative consequences of the industry (Wang et al., 2022). CSR in O&G companies, in terms of environmental sustainability, has as its goal the energy transition towards the exploitation of alternative energies (Chatzistamoulou & Tyllianakis, 2022). Institutional bodies, such as the United Nations, have laid the foundations for this transition through the 2030 Agenda and the Sustainable Development Goals. Efforts to accelerate the development of this transition make the O&G industry face issues such as restrictions on CO_2 emissions or reduced demand for fossil fuels (International Energy Agency, 2021).

Given the severe consequences of O&G exploitation, it is necessary for the industry to minimize its environmental and social impact. Currently, business is increasingly facing a socially responsible management of its activities, with the goal of being more sustainable and respectful of the environment and the society in which companies are framed (Engle, 2007). To do this, companies must carry out CSR practices within their daily activities (Peidong et al., 2009). This kind of practices can generate a positive impact on the perception of the company by stakeholders (Hasan et al., 2018). Authors such as Wieczorek-Kosmala et al. (2021) even argue that stakeholders pressure companies to make them more transparent and sustainable. However, the actions carried out by these companies must generate a considerable improvement in the Corporate Financial Performance (hereinafter, CFP) and in its market value, otherwise they will not be balancing all the interests of the stakeholders, especially those of the shareholders who will finally be the ones who will be able to take positions in favor of introducing changes towards sustainability in the corporate strategy of the companies (Nirino et al., 2020). According to this, the objective of an efficient energy transition is conditioned by the relationship between sustainability, CFP, and market value.

In this way, CSR management and its impact on the economic and financial performance of the O&G industry become the main pillars of the thesis. These two issues being the aspects that explain the energy transition, thus reducing the polluting impact that O&G industry has today. Thus, this new path involves elucidating whether sustainable practices in O&G companies are economically and financially profitable.

1.2 Literature review, research gap and main objectives

According to the European Commission (2001) CSR is defined as "a concept by which companies integrate social and environmental concerns into their business operations and interaction with stakeholders on a voluntary basis". A concept therefore that is closely related to environmental sustainability, being the energy transition and the use of alternative energies one of the ways to achieve it (Bridge et al., 2013). Authors such as Wang et al. (2022) suggest that the consumption of alternative energies reduces CO_2 emissions, which in turn reduces the environmental impact of energy.

In the previous literature CSR has been used disparately, then originally there was no single concept of it (Marrewijk, 2003). The first academic definition of CSR dates from 1953 and was proposed by Howard R. Bowen (1953): "The obligations of entrepreneurs to follow their policies, make their decisions or follow their lines of action that are desirable based on the objectives and values of society". Definitions with a general character gave way to more specific concepts, where dimensions such as economic, social, or environmental were glimpsed (Dahlsrud, 2008). It was not until 1992 with the work of William C. Frederick (1992) that the environmental dimension was introduced: "(...) Companies must be responsible for the effects of any of their actions on their community and environment." Years later, Elkington (1997) introduced in his seminal work “The Triple Bottom Line” concept. The author defines the three main components of sustainability as the social, environmental, and economic dimension, giving greater importance to the first two to the detriment of the traditional economic dimension. This approach has been applied to date. The United Nations Industrial Development Organization (2022) considers CSR a management concept where the balance of the company is given by the management of three dimensions: Economic, environmental, and social. To these factors is also added the factor of governance. Data providers such as Thomson Reuters report information on the latter factor which, together with the environmental and social dimensions, constitute the ESG index. The reporting of information based on the governance factor has been driven by an increase in the demand for information by stakeholders against possible mismanagement in corporate governance (Zhang & Zhu, 2013). This requirement arises from the numerous scandals that have been published in recent years, and that have affected the reputation of companies for CSR and governance purposes (Arvidsson, 2010). The cases with the greatest impact, among others, have been Enron, WorldCom, or Parmalat. This evolution in the concept of sustainability and CSR has been accompanied by a greater concern for environmental issues and for the development of the energy transition towards less polluting energy sources.

To identify the CSR activities carried out by companies, as well as their social, environmental and governance impact, ESG criteria began to be used as a method to assess these actions (Betriebswirtschaft, 2011). It is assumed that an efficient management of these criteria can have an impact on an increase in CFP, and therefore in market value (Plumlee et al., 2015). Many studies have analyzed the consequences of ESG factors on financial performance (Brantley et al., 2014), market risk (Shakil, 2021), market value (Behl et al., 2021), or cost of capital (Attig et al., 2013).

The importance of ESG criteria lies in the fact that they are measurable and valuable factors by stakeholders. Moreover, the financial market is beginning to take ESG factors into account for investment and financing activities. Proof of this is the emergence of Socially Responsible Investment (hereinafter, SRI), consisting of incorporating into the investment strategy factors of good practices related to ESG criteria (Miralles-Quirós et al., 2020). Authors such as El Ghoul et al. (2018) suggest that companies with a high level of social and environmental responsibility transfer this performance to the economic-financial aspect, leading to an increase in the profitability of investors in the market. Others such as Bauer & Hann (2012) argue that sustainable companies tend to be associated with low debt costs and high credit rating.

Considering the growing importance of ESG criteria in the market, energy companies are aiming to minimize their social and environmental impact and be profitable simultaneously. This relationship between ESG criteria, CFP and market value is explained through two theories: stakeholder theory (Jensen & Meckling, 1976) and agency theory (Freeman, 1984). It argues that socially and environmentally responsible performance can lead to value creation for stakeholders (Rodgers et al., 2013). As for agency theory, it finds an adverse relationship between corporate management and stakeholder incentives in relation to responsible performance (Hussain et al., 2018). In this sense, CSR practices could cause agency problems.

Extensive previous literature has examined the relationship between CSR and financial performance (Badía et al., 2020; Bodhanwala & Bodhanwala, 2020). As for energy companies, they can contribute to increasing sustainability in the environment and society by reducing CO_2 emissions, improving labor rights, or increasing the efficiency of resource use. For these reasons, among others, the literature establishes a positive relationship between CSR and financial performance. Authors such as De Lucia et al. (2020) maintain a positive relationship between indicators of environmental efficiency and financial profitability. Others such as Jiang et al. (2018) suggest that greater proactivity in environmental responsibility positively impacts financial performance. For Hoang et al. (2020) the relationship between ESG factors and financial performance varies according to the period. Short-term investments in alternative energy have a negative impact on financial performance. On the other hand, for the long term the results are positive and significant.

According to previous literature, the thesis identifies certain gaps in the research that analyzes the impact of ESG criteria on CFP and market value. In Chapter 2, we find that previous studies have linked CSR and company value and CSR and market risk, separately (Ait Sidhoum & Serra, 2017; Champagne et al., 2021). On the other hand, and according to the literature studied, it has not been possible to identify studies that carry out an empirical analysis of the CSR relationship (through ESG criteria) and the holistic corporate financial strategy (financial performance, market risk and market value) within the O&G industry. In this vine, one of the objectives set out in Chapter 2 is to analyze whether ESG criteria influence the value of O&G companies, as well as their effect on financial performance and market risk. Another of the gaps identified in this kind of studies is the approach of ESG criteria as individual and separate dimensions (Jiang et al., 2018; Paolone et al., 2021). Chapter 2 contributes to the discussion in this aspect with the development of a new index that includes all three dimensions simultaneously (Environmental, Social and Governance). In this way, another objective is to raise the relationship of ESG criteria in full with the corporate financial strategy and market value of O&G companies. Based on this approach, we try to answer the research question: does CSR, measured through the ESG index, affect corporate financial strategy and its market value in the O&G industry?

Once the relationship between sustainability, corporate financial strategy and market value in O&G companies has been tested, Chapter 3 introduces ESG Controversies (hereinafter, ESGC) as a moderating variable. This new variable measures companies' exposure to negative events reflected in the global media. Previous literature has analyzed the impact of ESGC partially. Authors such as Aboud & Diab (2019) and De Franco (2020) argue that an increase in bad news directly affects market volatility for certain industries. Others such as Nirino et al. (2021) suggest a negative relationship between ESGC and CFP, but do not demonstrate the moderating effect on the ESG factors – CFP link. However, and considering that O&G companies are one of the industries with the greatest negative impact at the social and environmental level, previous literature has not focused on this industry to identify whether there really is a moderating effect on the sustainability-market value link. With this research gap, Chapter 3 aims to identify whether ESGC moderate the sustainability-market value link in O&G companies, answering the research question: can the sustainability-market value link be affected by bad reputation, as measured by ESGC?

Analyzing the impact of ESG and ESGC factors on corporate financial strategy and the market value of the global O&G industry, the thesis contributes to the discussion on the necessary energy transition of the industry through Chapter 4. The study of alternative energies is of great importance for the achievement of public policies that allow improving the profitability of private investments in this kind of energy sources. However, previous literature is underdeveloped in this regard. Most studies focus on causal relationships between oil prices or changes in technology (Inchauspe et al., 2015; Kumar et al., 2012). Moreover, the literature could be incomplete in terms of financial and environmental performance and suffers from inconsistencies caused by the sample, the period or the methodology selected. In this sense, Chapter 4 aims to fill this research gap by answering the following questions: Can investors expect higher returns on renewable energy indices while bearing greater risk? Is it more cost-efficient to invest in renewable energy indices than conventional indices?

1.3 Methodology

To achieve the objectives proposed in the thesis, it has been provided quantitative methodology applied to financial valuation. Chapters 2 and 3 apply a statistical approach based on the Partial Least Square – Structural Equations Modeling (PLS-SEM). The approach was used for a total of 219 global O&G companies (Chapter 2) and 264 global O&G companies (Chapter 3). Regarding Chapter 4, the methodological approach used was the Fama – French five factor model used as an ordinary least squares regression for a set of sustainable, renewable energy and conventional market indices.

Chapter 2 seeks to clarify the relationship between the ESG index and its relationship to CFP and the market value of O&G companies. Based on previous knowledge, the main contribution of Chapter 2 is the development of a new ESG index through a set of variables extracted from the Eikon DataStream database. A total of 10 variables were used distributed as follows: Three environmental variables (resource use, emissions, and environmental innovation), four social variables (community, human rights, workforce and product responsibility) and three governance variables (shareholders, management and CSR strategy). Regarding the economic-financial variables that influence financial performance, market value and market risk were also extracted from the Eikon DataStream database. Return on Asset (ROA) and Return on Equity (ROE) explain financial performance; the closing price and the Market Value of Company (MVC) make up the market value; and finally, the CAPM Beta and the Sharpe ratio explain the market risk. All the previous variables were obtained for a total of 219 global O&G companies framed in 2020. According to the objectives of the thesis, the sample used allows specialization in the study of O&G industry. The statistical analysis was based on PLS-SEM, using the SmartPLS 3.3.3 program.

Once the sustainability – CFP – market value link has been tested, Chapter 3 aims to analyze the moderating effect that ESGC could have on this relationship. To achieve this objective, a sample of 264 global O&G companies was used for the year 2019, allowing us to be focused again on the study of this industry. The data was extracted from the Eikon DataStream database. The statistical analysis was based on PLS-SEM developing a model composed of five constructs, with the Environmental, Social and Governance pillars and the ESGC as the four exogenous variables; CFP was the only endogenous variable. The variables used for the explanation of ESG pillars were the same as in Chapter 2. Regarding the economic-financial variables, the closing price, the Market Value of Company (MVC) and the Tobin Q were used. ESGC is a variable extracted directly from the database and measures the exposure that companies must negative events published in the international media. We use ESG pillars separately to test the relevance of each CSR practice on CFP based on indicators used in previous studies.

Finally, and considering the energy transition framework in which the thesis is developed, Chapter 4 aims to compare the risk – return ratio of sustainable and renewable energy indices respecting to conventional indices, identifying in this sense the attractiveness of alternative investments for international financial markets. To respond this, Chapter 4 provides a sample composed of 30 international stock market indices (16 sustainable and renewable energy and 14 conventional). A study period between 2011 and 2019 was used, extracting most of the data from the Eikon DataStream database, and consulting those that were not available in the specific databases of stock index developers. The statistical approach used was the Fama – French five factor model. To carry out the model, the annualized daily return of each of the indices was used as an endogenous variable or to be explained, while the exogenous or explanatory variables were the 5 factors proposed by Fama and French in their seminal article. The data repository published by French (2020) was used for the extraction of these data.

1.4 Results

Throughout the chapters, the detailed results of each analysis will be presented. However, we will try below to indicate the most relevant. The main results drawn from Chapter 2 are:

- The factors that have a significant weight on the formation of the ESG index are Environmental and Governance.

- Due to the high weight and significance of the Environmental factor on the ESG index, and the latter on CFP, it is concluded that a greater commitment to this factor has an impact on better financial results for O&G companies.

- A negative and significant relationship is found between the ESG index and market risk, confirming that an optimal CSR profile contributes to greater market confidence, and therefore to a reduction in volatility in value.

- Financial performance is significantly more important than market risk when analyzing the value of a company. This difference may be determined by the fact that ESG factors already intrinsically recognize the market risk of the O&G industry.

- The improvement of the ESG profile has a positive and significant influence on the market value in the O&G industry.

Once the sustainability – CFP link has been tested in Chapter 2, Chapter 3 aims to analyze the moderating effect of ESGC on the relationship between ESG factors and CFP. The main results extracted are:

- ESGC have a significant negative impact on CFP.

- ESGC have a moderating effect on the Environmental – CFP link and Social – CFP link.

- An increase in negative events that impact on the CSR practices of O&G companies reduces the positive effect on the relationship between environmental and social sustainability and CFP, making the CSR strategy less efficient from a financial point of view.

- Environmental and Social factors have a positive and significant impact on the value of O&G companies.

Having carried out the detailed analysis of the sustainability – CFP link for the O&G industry in Chapters 2 and 3, Chapter 4 aims to examine the investor attractiveness of a set of sustainable and renewable energy indices compared to investment in conventional indices. The main results extracted are:

- The market beta or systematic risk for the set of renewable energy indices is significantly high, above one in many cases, which makes it a very risky industry from the investment point of view. Moreover, these high market betas accompanied by negative values of the Alpha factor (returns), makes investment in renewable energy unattractive.

- The risk – return ratio in renewable energy indices is less attractive (high risk, low return) compared to conventional indices.

- DJSI indices report a lower market beta compared to conventional indices, and an higher return, except for DJSI North America. This makes it have an acceptable risk – return ratio.

- Indices with an environmental dimension (renewable energy indices) are less profitable and riskier than those with a general sustainability dimension (DJSI).

- As a result, investors still do not consider investing in renewable energy as an attractive alternative, as risk levels are high and returns low.

1.5 Main conclusions and limitations

After achieving the objectives indicated above, and extracting the most relevant results, we will discern those conclusions that have been reached throughout the thesis.

The research carried out in Chapter 2 concludes that markets are influenced by the actions that O&G companies carry out at the Environmental and Governance level. Specifically, an improvement in Environmental and Governance factors contributes to an increase in financial performance and market value. Moreover, the improvement of those contributes to reduce the financial risk and volatility of the company in the market. This means that a greater emphasis on environmental and governance policies improves market confidence in O&G companies. Being the Governance factor, it is not as significant as the Environmental factor, the latter being considered as the most influential in the explanation of the ESG index. In turn, the influence of financial performance and market risk on market value is tested. Thus, although both variables influence the market value, market risk has a considerably smaller impact on that value. This may be because investors already consider the sustainable profile as an indication of risk, no longer treated as a peripheral issue to become a key piece when valuing O&G companies.

Regarding Chapter 3, it is confirmed that there is a moderating effect of ESGC on the relationship between Environmental and Social factors and CFP. That is, a reduced number of negative events that impact O&G companies will allow environmental and social policies to contribute more to the improvement in CFP, compared to those that may be affected by a greater number of bad news.

Finally, Chapter 4 tries to answer how attractive (depending on the risk – return ratio) is for markets investment in sustainability and renewable energy compared to conventional investment. This chapter concludes that investors do not find it attractive to invest in renewable energy indices as they report higher risk and lower returns than conventional indices.

While it is true that the thesis provides relevant contributions to the knowledge of sustainability and its economic-financial viability within the O&G industry, it has certain limitations. As for Chapters 2 and 3, the period is just one year which can cause loss of information by not considering a longer period. The sample is global, which means that the selected companies may be subject to specific government regulations, and therefore the data analyzed are affected by this issue. Moreover, a global sample does not allow the focus on a specific region, which could contribute to increasing the depth of the analysis and even to carry out comparative studies between them. Also, in relation to the sample, once the analysis focuses on O&G companies, it no longer considers a relevant part of the energy industry, such as renewable energy or nuclear companies. As for Chapter 4, the use of a single statistical model (Fama – French 5 factor model) limits the robustness of the results and does not allow contrast with other models such as Carhart 4-factor model. Regarding the sample, as they are stock market indices, the study does not allow to delve into the companies that are part of each index or to what type of industries they belong. On the other hand, it is well known that the market reacts sharply to certain events that happen globally of a political, economic, or social nature. These kind of key moments were not considered during the analysis.

CHAPTER II. UNDERSTANDING THE RELATIONSHIP BETWEEN THE ESG INDEX AND CORPORATE FINANCIAL PERFORMANCE. EVIDENCE FROM THE GLOBAL OIL AND GAS INDUSTRY

IS THE CORPORATE FINANCIAL STRATEGY IN THE OIL AND GAS INDUSTRY AFFECTED BY ESG DIMENSIONS?

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IS THE CORPORATE FINANCIAL STRATEGY IN THE OIL AND GAS INDUSTRY AFFECTED BY ESG DIMENSIONS?

Abstract

The oil and gas industry is under pressure because of the impact it has on sustainability. Company's stakeholders are aware of the ethical behavior of those companies relate to hazardous activities. Literature have analyzed the relationship between Corporate Social Responsibility and different measures of efficiency (e.g., financial performance or market value) without a conclusive result.

This research set up an ESG index (Environmental, Social and Governance) that allows a comprehensive measure of corporate social responsibility and its effects on corporate financial strategy. The study analyzes how ESG index influences in the value of Oil and Gas companies as well as in their financial performance and financial risk. To do this, it has been applied PLS-SEM to a sample of 219 Oil and Gas companies in different countries. Results show that Environmental and Governance dimensions are the backbone of the ESG index that impact positively on all three.

Keywords: ESG, financial performance, market risk, market value, oil and gas

1. Introduction

Corporate Social Responsibility (CSR) is *"a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis"* (European Commission, 2001). The implementation of CSR activities in a given company is to achieve the opportunity to get the truth of stakeholders (Streimikiene et al., 2009). However, the engagement in CSR as indicator of companies' sustainability or sustainability development is a complex topic of addressing, especially in the energy industry; what is more, as Streimikiene et al. (2009) write, *"CSR is a guiding principle that underpins corporate vision, strategy and decision-making and represents a series of emerging issues that must be ''managed'' by the energy company in order to maintain its ''license to operate''.*The term CSR has grown in importance and significance since the 1950s. Several definitions have proliferated[1] in the literature from the initially definition introduced by Bowen (1953). Later, especially the contribution of Carroll (1999) through the diffusion of CSR Pyramid, expanded companies' responsibilities to four dimensions: economic, legal, ethical and philanthropic. Carroll (1999) states that *"company should strive to make a profit, obey the law, be ethical, and be a good corporate citizen"*. Evolving over the years, literature supports that the performance and success of a company is also measured through social and environmental dimensions as same as economic (Dahlsrud, 2008; Norman & Macdonald, 2004). Therefore, it is clear CSR is a multi-dimensional construct based on Environmental, Social and Governance (ESG) scores (Terjesen et al., 2009; Terjesen et al., 2016; Sassen et al., 2016).

A plethora of studies has analyzed the consequences to engage in CSR activities, examining their effect on financial performance (Ambec & Lanoie, 2008; Brantley et al., 2014; Pätäri et al., 2012), market risk (Albuquerque et al., 2019; Chollet & Sandwidi, 2018; Sadorsky, 2001; Shakil, 2021), company value (Behl et al., 2021; Fatemi et al., 2018; Gong et al., 2021; Miralles-Quirós et al., 2019) or cost of capital (El Ghoul et al., 2011).

The above relationships are ascribing to the stakeholder theory (Freeman, 1984) and the agency theory (Jensen & Meckling, 1976). Both theories have been used by practitioners to assessment the benefits and costs of CSR practices in a company. From the stakeholder theory, companies should address the demands of stakeholder's interest

[1] See Dahlsrud (2008).

(Freeman, 1984), not only to serve to the interest of shareholders (Friedman, 1970). This theory points out that companies enhancing relationship with employees, clients, suppliers, community and the environment provide benefits to the company as well as the shareholders (Hasan et al., 2018). Furthermore, according to the agency theory, CSR could be the manifestation of agency problems inside the company because managers (agents) benefit opportunistically on investments in CSR (Champagne et al., 2021; Krüger, 2015). Authors such as Borralho et al. (2020) note that governance factors appear to contribute to mitigating potential conflicts of interest in agency relationships in family businesses.

Industries with a hazardous nature have more pressure to engage in CSR practices in their core business to underpin a long-term economic value because of their greater exposure to environmental and social concerns in comparison with others such as insurance, financial or consumer goods (Beck et al., 2018; Shahbaz et al., 2020). This is the case of the Oil and Gas (O&G) activities as current main sources of energy (Eurostat, 2022; International Energy Agency, 2021) they are aware to move towards more sustainable energy model (International Energy Agency, 2021). Given the singularities of that industry, O&G companies are under the spotlight of investors, governments, ecologists, and general population for the highly evident negative environmental effects of their daily processes. With the increment pressure of each stakeholder, companies responded to applying more sustainability policies and regulations (International Energy Agency, 2021; Loorbach, 2004; Masson-Delmotte et al., 2021; United Nations, 2015). From the “Paris Agreement” established in 2015 until the Sustainable Development Goals (SDGs) proposed in the “Agenda 2030” to meet sustainability challenges (United Nations, 2015), O&G companies understood the important role that play to combat environmental and social problems attached to their production and consumption (e.g., geopolitical conflicts, gas and venting of CO_2, tackling methane emissions, local disruption, and water contamination).

While different studies have been devoted to relation between CSR and financial performance, CSR and company value and CSR and market risk, separately, as far as we know no empirical studies have addressed the net of relationships between CSR and the corporate financial strategy which allows us to deepen in those relationships. The objective of this work is to analyze whether the Environmental, Social, and Governance dimensions influence in the value of O&G companies as well as their effect on financial performance and market risk, which impact in the market value too. To do this, unlike previous studies, we developed a new index that includes the three dimensions (the ESG index). Until now, previous studies have analyzed the aforementioned relationships across the dimensions, individually and separately (Aouadi & Marsat, 2018; Ferrero-Ferrero et al., 2016; Jiang et al., 2018; Lins et al., 2017; Oikonomou et al., 2012; Paolone et al., 2021; Pätäri et al., 2012; Shakil, 2021). For example, Taliento et al. (2019) use the ESG score with weights subjectively weighted by the data provider however do not use Environmental, Social, and Governance scores separate and individually. López-Toro et al. (2021) use Environmental, Social, and Governance scores individually but do not construct an index from these dimensions as we do in this work. Therefore, the significance of the present research is to highlight all crucial relationships between CSR profile and corporate financial strategy at once; CSR-financial performance, CSR-market risk as well as CSR-market value, showing that there is a much wider class of models.

To our knowledge, this article is the first to contribute to this ongoing discussion by providing a robust nomological network between financial variables and the Environmental, Social and Governance index for O&G companies. To achieve this purpose, we used Partial Least Square Structural Equation Modeling (PLS – SEM) to generate a new ESG global index and its relationship with the corporate finance strategy in a sample of 219 O&G companies for 2020. Furthermore, our contribution is also based on the hierarchical analysis approach used to build ESG index. This ESG-company score is based on the information score of the three pillars (Environmental, Social and Governance) and the internal weighting assigned by the non-parametric PLS-SEM method. In contrast to previous literature, we avoid subjective assignments in the ESG index estimation in accordance with previous literature (Callan & Thomas, 2009; Gyönyörová et al., 2021) that considered these weights inadequate. Finally, the importance, in economic and production terms, both subindustries within the energy industry serves as the justification for this study (International Energy Agency, 2021; Lu & Lai, 2019). Our results determine that O&G companies tend to align their environmental and social responsibilities with the stakeholders' demands to improve their benefits in terms of financial return, risk, and maximizing market value.

The remainder of the article is presented as follows. Section 2 addresses a detailed literature review and sets the research hypotheses. Section 3 presents data and methodology used. The results are reported in Section 4. The discussion and main conclusion found in Sections 5 and 6.

2. Literature review

Energy companies, more specifically O&G, have environmental and social threats where they operate and thus, need the implementation of ESG practices in their business operations. For example, the carbon emission of this industry (62 per cent over the total) makes up the vast majority of the greenhouse gases (GHG) emissions (International Energy Agency, 2021) that causes the global warming. In the current context, energy companies must respond properly to national and international government regulations, guidelines, social expectations, or investors requirements. Hence, to get the support of different stakeholders, companies have committed in CSR practices (Demirbas, 2009). Due to the uniqueness of this industry, the challenge of energy companies is the implementation of sustainability practices being efficient. Thus, energy companies are pretended to minimize their environmental and social impacts being profitable simultaneously (Pätäri et al., 2014).

ESG scores are not only about the environmental impact of business practices but also describe social and governance performance of companies (Terjesen et al., 2009; Terjesen et al., 2016). ESG scores and nexus to financial indicators are explained by two different theories: stakeholder theory (Jensen & Meckling, 1976) and agency theory (Freeman, 1984). Stakeholder theory highlights that CSR practices are tether to stakeholders interests (Hasan et al., 2018). There is a value creation for stakeholders and also this is spread to the shareholders when companies perform on CSR (Rodgers et al., 2013; Freeman & McVea, 2005). Therefore, companies with higher ESG scores may probably have better results. Agency theory finds an adversarial relationship between corporate management and stakeholders' incentives to be responsible (Hussain et al., 2018). CSR practices could generate agency problems, that is, a conflict with the shareholders' objective of the company (maximize their value). In this vein, monitoring mechanics could mitigate the opportunistic behavior of the agents by board independent and board diversity (Shahbaz et al., 2020; Ho & Wong, 2001). Even the legitimacy theory (Dowling & Pfeffer, 1975) is sometimes used regarding the degree of disclosure of corporate social information because it affects the reaction of interested parties to a company. As Patten (2005) suggests, companies that ignore socially recognized values may lose their social legitimacy.

2.1 ESG index and financial performance

Extant literature has examined the connection between CSR and financial performance (Kurapatskie & Darnall, 2013; Sassen et al., 2016; Badía et al., 2020; Bodhanwala & Bodhanwala, 2020). Under this approach, socially responsible companies will get the support of a wide array of stakeholders. Therefore, energy companies can contribute to environmental and social sustainability by reducing pollution, carbon dioxide emissions, strengthening worker rights or improving efficiency. This engagement will enhance customer loyalty, corporate reputation, and worker productivity (Freeman, 1984; Hasan et al., 2018). For all these reasons, and the like, literature establishes a positive relationship between CSR and financial performance. For example, Pätäri et al. (2014) examined Granger causality between investments in CSR and companies' financial performance in the energy industry. Results evidenced that CSR (strengths and concerns) should be treated separately because their results were different according to the performance measure selected. CSR strengths, that is, actions such as selling pollution-control technology or better access to certain markets (Jiang et al., 2018) have only impact on market value. Whereas CSR concerns (i.e., damaging actions with the social or environment) influence ROA and market value. Pätäri et al. (2012) analyzed whether socially responsible companies performed better than those that do not follow sustainability goals. Analyzing a sample of 210 energy companies found that, implementing CSR practices, companies monitoring cost and got better profits than the more conventional companies. Furthermore, this relationship is see-through to use as measurement of the market-capitalization value. Previous results are in line with Jiang et al. (2018), they showed a positive association between proactive corporate environmental responsibility on financial performance for Chinese energy industry. Ekatah et al. (2011) supported that companies with higher CSR score will get better economic profitability. They got this finding for the Shell Plc. Indeed, Ait Sidhoum & Serra (2017) confirmed that the adoption of cleaner technologies implies an efficiency and financial performance improvement. This relationship was less evident for highly capitalized companies in the electricity industry for 2005 to 2012. However, some authors also argued a non-significant relationship between ESG scores and financial performance. In this sense, López et al. (2007) documented a non-significant relationship between sustainability investments' and market value. Marsat & Williams (2013) analyzed energy companies for the period 2011 to 2018. They argued that there is no significant relationship between CSR and financial performance (market value and accounting). According to

Shahbaz et al. (2020), higher ESG scores do not ensure better financial performance measured by the Tobin's Q and the return on assets. Using a dynamic panel regression, the results displayed a no predictive value of CSR activities on performance. While Hoang et al. (2020) argued that the relationship between ESG scores and financial performance varies according to the period. Short-term investments in clean energy business have a negative impact on financial performance (proxied by market value and ROA). But, in the long term, previous results were positive and significant.

All in all, previous research shows various and inconclusive findings in the energy industry. Some justifications for the positive association between CSR and financial performance are based on the stakeholder and agency theoretical frameworks. In this sense, CSR activities will attract stakeholders increasing profits and reducing risk and agency problems (Tzouvanas & Mamatzakis, 2021). On the contrary, other studies highlighted that CSR will not exceed the benefits, making unstable financial results (Champagne et al., 2021; McWilliams & Siegel, 2001). Therefore, we posit the following hypothesis:

*H_1***.** *Higher the ESG scores, imply higher the financial performance of O&G companies.*

2.2 Financial performance and market value

Some researchers show a close relationship between companies' financial performance and market valuation (Ambec & Lanoie, 2008; Tzouvanas & Mamatzakis, 2021). As a matter of fact, financial performance is one of the most important sources of information when companies are included in the investment portfolio of investors and investment funds (Hernaus, 2019; Schröder, 2007). In general, a plethora of studies highlight that CSR generate strong financial performance (Albuquerque et al., 2019; Griffin et al., 2020; Ng & Rezaee, 2015). Mackey et al. (2007) stated that companies engage in CSR activities notwithstanding, it might not maximize the present value of a company's cash flows but this engagement enlarges the market value of the company. Evidence shows that, in general, stakeholders consider that CSR practices will increase the stock prices of companies (Tzouvanas & Mamatzakis, 2021). Shakil (2021) showed that financial variables (cash flow, debt ratio, and cost of capital) have a positive relationship with the market value in international markets. An improvement in the previous financial indicators allows companies' valuation shows an upward trend in markets. According to Chava (2014), investors demand higher returns for hazardous industries. In this sense, O&G companies will give more importance to adapting their activities to environmental requirements. It makes markets more confident of their economic results and favor their market value. Lastly, Shanaev & Ghimire (2021) found that companies with CSR investments outperform in risk-adjusted returns. To address this concern, we postulate this hypothesis:

H_2: Higher financial performance, imply higher market value in O&G companies.

2.3 ESG index and market value

Shareholders generally are attracted by sustainability policies in the energy industry. A body of research has found that ESG positively affects companies' value creation (Aboud & Diab, 2019; Landi & Sciarelli, 2019). Even though, some authors also provided a negative association between the quality of corporate governance and market value (Batae et al., 2021). Furthermore, Miralles-Quirós et al. (2019) demonstrate that ESG performance gains more incremental value after the global financial crisis, based on the value investors attach to the three ESG pillars. According to Lins et al. (2017), companies with high CSR rating showed higher profitability, growth and efficiency compared to low CSR rating companies. Paolone et al. (2021) evidence that investors' perception was directly affected by CSR performance of companies, highlighting that companies with high-ESG scores will generate higher stock returns and profitability and therefore, higher market value. Many other researches also documented similar findings (Chan & Walter, 2014; Ferrel et al., 2016; Hernaus, 2019; Arefeen & Shimada, 2020). For instance, Fatemi et al. (2018) argued that CSR strengths raise company's valuation and weakness lowering it. Borghesi et al. (2014) highlighted that ESG practices could be driven as a part of strategy to create goodwill or maintain a good reputation. Their finding evidences a positive association between higher level of CSR investments and greater free cash flow. In addition, Ferrero-Ferrero et al. (2016) similarly provided evidence that investors improve their trust in companies when these give off a socially and environmentally responsible image. Market valuation is directly affected by these kinds of efforts. Otherwise, Meynard (2014) or Naumer & Yurtoglu (2020) did not find a direct relationship between social reputation and market value within the energy industry. These authors also concluded a non-significant relationship between ESG controversies score and market value (Benlemlih & Girerd-Potin, 2017; Nguyen-Van, 2010; Sila et al., 2016). Thus far, Dyck et al. (2019) assert *"companies are stepping up their environmental and social performance because* *investors are asking for it"*. Therefore, we proposed the following hypothesis:

H_3: Higher the ESG scores, imply higher the market value of O&G companies.

2.4 ESG index and market risk

Empirical research generally shows that engagement in environmental, social, and governance practices reduces company risk (Albuquerque et al., 2019; Dilling & Harris, 2018; Shakil, 2021). Champagne et al. (2021) expose that better ESG scores, i.e., better management of companies' stakeholder, will reduce the impact of several kinds of risk such as loss of revenues, regulatory sanctions, or declining share prices. Oikonomou et al. (2012) observed in a sample of US companies, a negative association between CSR and systematic company risk. However, they did not find relationship between some social strengths (i.e., product safety or quality) and systematic risk, whereas social concerns were positively and significantly related to company risk. Understanding risk as market volatility, company's probability of default, or reputational effects (Arefeen & Shimada, 2020; Bollerslev & Ghysels, 1996). The main result is that ESG scores reduce the volatility in the companies' market price, that is, in their financial risk (Lueg et al., 2019; Shakil, 2021; Shakil et al., 2020). Albuquerque et al. (2019) showed, for a panel of 28578 US observations, a lower level of risk when CSR scores were higher. They considered CSR as a product differentiation strategy that make more negatively this relationship. In particular, the above relationship is especially relevant in the energy industry, O&G companies implement business strategies to address main risks create in the area where are located (Vicente et al., 2004; Correljé & Van Der Linde, 2006; Brantley et al., 2014). However, a very limited studies have focused on ESG index and market risk in the energy industry (Lemke & Petersen, 2013). Kuo & Chen (2013) argued that companies in environmentally sensitive industries should have responsible environmental policies to mitigate systemic market risk which is supported by the legitimacy theory. They analyses this relationship for a sample of 208 companies listed in the Japan Nikkei Stock Index. Pegg (2012) highlighted that, O&G Chinese companies have demonstrated how, with more socially responsible policies, their overseas operations increase and become more economically beneficial in the long term. We hence propose the following hypothesis:

H_4: Higher the ESG scores, imply lower market risk in O&G companies.

2.5 Market risk and market value

Lastly, economic, and social risks may affect the companies' performance that operate in financial markets. The above literature shows how social and environmental performance can impact on companies' risk, measured by the price volatility. The volatility often reduces the market value of companies in international markets (Söderbergh et al., 2007; Chia et al., 2009; Arouri et al., 2012). Jo & Na (2012) claim that energy companies, that face additional risks than do other industries (i.e., consumer goods, financial or insurance), look for greater environmental and social engagement to drastically reduce their market risk. Likewise, market risk is related to the share price of companies. As risk increases, market value decreases, and vice versa. In recent years, growing literature, focus on the energy industry, showed that market risks arise from different causes such as O&G prices (Demirbas, 2009; Sadorsky, 2012), the supply of and demand for (Solomon & Krishna, 2011; Acharya et al., 2013) and from ESG controversies (Meynard, 2014; Naumer & Yurtoglu, 2020). In fact, risk management theory argues that CSR generates moral capital and relational companies' wealth implying that during periods of financial crisis, companies have a support which allows them reducing negative markets' impact (Chakraborty et al., 2019). Then, the connection between CSR and market risk is negative. Especially, O&G companies lead an intrinsic risk associated to their activity. In this sense, the environmental risk management theory indicates that a good control of these damages, through ESG practices, will result in an improvement of companies' reputation and market value (Boudet et al., 2014; Shakil, 2021). We thus propose the last hypothesis:

H_5: Higher market risk, imply lower market value for O&G companies.

Figure 1 shows the relationships hypothesized in the previous literature above and establish our theoretical framework. The investigation between CSR profile and O&G companies' corporate finance strategy is established.

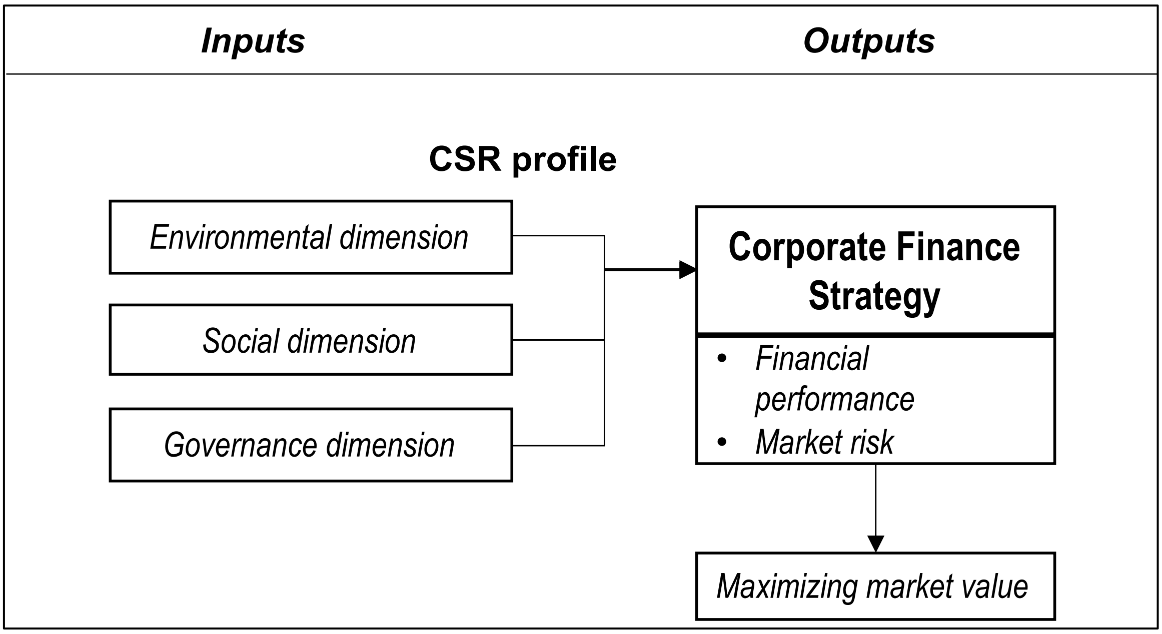


Figure 1. Theoretical framework for CSR profile and Corporate Financial Strategy

3. Method

3.1 Data and sample

The data for this study came from Refinitiv Eikon DataStream. This database contains financial and economic information and ESG parameters for more than 9,000 companies across 175 countries (Refinitiv, 2021). Refinitiv's Eikon database retains data for environmental, social and governance performance on more than nine thousand companies.

In our empirical application, the ESG index was formed by the Environmental, Social and Governance pillars. Environmental evaluates the influence of company's effects on air, land, water, and the ecosystem. This score measures how well a company uses best management practices for long-term shareholder value based on its ability to avoid and capitalize on environmental risks (Refinitiv, 2021). Social pillar measures an organization's ability to generate trust and loyalty with its customers, workforce, and society. These factors influence the company's ability to generate long-term shareholder value, including its reputation and the license to operate (Refinitiv, 2021). Governance pillar measures the company's ability to manage its rights and responsibilities by creating incentives and checks and balances, in order to create long-term shareholder value (Refinitiv, 2021). The governance dimension is reflected in the information of the indicators of management, shareholders, and CSR strategy scores. Each pillar scoring is divided into ten categories: three environmental (resource use, emissions, and innovation), four social (community, human rights, workforce, and product responsibility), and three governance categories (shareholders, management, and CSR strategy). The pillar score is ranging from 0 (lowest) to 100 (highest). Refinitiv uses this percentile rank scoring methodology to define the scores (E, S, and G) between 0 and 100 through the analysis of publicly reported data by more than 150 content research analysts across the globe.

On the other hand, Eikon database also presents economic and financial data related to financial performance, market risk and market value. According to previous literature, we use Return on asset (ROA) to capture operating performance and we capture financial performance through Return on equity (ROE) (Martins, 2021; Sachin & Rajesh, 2021; Shahbaz et al., 2020). ROA is calculated as the income after taxes for the fiscal period divided by the average total assets. ROE is computed as the income available to common excluding extraordinary items for the fiscal period divided by common equity. Lins et al. (2017) and Miralles-Quirós et al. (2019) use the closing price to reflect the market value, and Aouadi & Marsat (2018) and Pätäri et al. (2012) use the indicator of market capitalization. Price close is the latest available closing price. Market Value of Company (MVC) is the consolidated market value of a company displayed in local currency. MVC for companies with a single listed equity security is the share price multiplied by the number of ordinary shares in issue. Finally, market risk is less common. Only a few recent papers mention CAPM Beta or the Sharpe ratio (Hernaus, 2019; Naffa & Fain, 2021). CAPM Beta is a measure of how much the stock moves for a given move in the market. It is the covariance of the security's price movement in relation to the market's price movement. The Sharpe ratio or reward-to-variability ratio is a measure of the excess return (or risk premium) per unit of risk in an investment asset, named after William Forsyth Sharpe.

Once all the previous variables were obtained, we got information for 245 O&G companies worldwide for 2020. After the exclusion of missing values, we discarded around the 11% of the initial observations, the final sample comprised 219 O&G companies. Table 1 summarize the variables used in the analysis. The sample used secondary and cross-sectional data was tested. To determine the minimum sample size needed, we follow Faul et al. (2009). The results of applying a significance level of 0.05 with an effect size f^2 of 0.15 using G*Power software were satisfactory. A required size of 119 observations with statistical power of 0.95 was indicated while we validated 219 observations.

Table 1. Composites and description of indicators.

Composites	Indicators	Description
Environmental (Mode B)	E1	Resource use score
	E2*	Emissions score
	E3	Environmental innovation score
Social (Mode B)	S1	Workforce score
	S2	Human rights score
	S3	Community score
	S4	Product responsibility score
Governance (Mode B)	G1	Management score
	G2	Shareholders score
	G3	CSR strategy score
Financial performance (Mode A)	ROA	Return on asset (total assets)
	ROE	Return on equity (common equity)
Market value (Mode A)	P	Price close
	lnMVC	Logarithm of market value for company
Market risk (Mode A)	Beta	CAPM Beta
	Sharpe	The Sharpe ratio

Source: Eikon from Thomson Reuters, 2020. Note: * These indicators were not included in latent variables due to problems of multicollinearity.

Table 2 shows the descriptive statistics where the highest values of the indicators E, S, and G corresponded to *S1* or the workforce score that contains data on diversity, turnover of employees, training and development policy, health and safety policy, equal opportunities, flexible working hours and salary gaps, and *S3* community rating whose data includes bribery, fair competition, corruption, community involvement, business ethics, and community lending (both 99.80). As well as *E2* or emissions score (99.79) related to the emission policy and objectives, total CO_2 emissions, climate change opportunities, environmental restoration, waste management, environmental expenses and income, reduction of the impact of personnel transportation. The product responsibility rating *S4*, also starts from an average value of 90.78, thus highlighting that this dimension weighs heavily in the ESG components of O&G companies as a controversial industry (Aouadi & Marsat, 2018), compared to the rest of the attributes of pillars E, S, and G. Likewise, *E1* or the resource use score, also represents a high maximum value of 99.76 in the 219 companies with data for this score, where factors such as water and energy efficiency are considered policies, total energy and water use, environmental management systems, renewable energy use ratio, supply chain management and monitoring, and green buildings. Within the governance dimension, the *G2* shareholders score (99.68) indicator stands out, which includes voting cap percentage, equal shareholders rights and specific policies, shareholders vote on executive pay, anti-takeover devices, director election majority requirement, veto power or golden shares, auditor tenure, and non-audit to audit fees ratio. In second place, the management score *G1* (99.67) is positioned with data on CEO – chairperson separation, compensation, corporate boards, the nomination committee and its independence, the succession plan, remuneration packages linked to the total shareholders return, and internal audit, among others.

Table 2. Descriptive statistics

Variables	Mean	Std. Deviation	Minimum	Maximum
E1	43.60	32.37	0.00	99.76
E2	49.37	30.69	0.00	99.79
E3	15.54	27.05	0.00	80.67
S1	52.67	29.61	40.00	99.80
S2	33.41	33.81	0.00	95.39
S3	51.34	29.39	79.00	99.80
S4	46.44	29.26	0.00	99.78
G1	54.19	30.69	2.00	99.67
G2	54.59	28.64	54.00	99.68
G3	50.37	33.38	0.00	99.63
ROA	-0.11	0.19	-0.81	0.15
ROE	-0.45	1.66	-19.66	0.49
lnMVC	9.38	0.84	7.20	11.36
P	14.06	25.98	0.01	221.13
Beta	1.90	1.09	0.00	6.85
Sharpe	-0.01	0.11	-0.40	0.48

Source: Own elaboration based on Eikon database for a sample of N = 219 companies. Note: *E1, E2* and *E3* means Resource use, Emissions, and environmental innovation scores. *S1, S2* and *S3* means workforce, human rights, community, and product responsibility scores. *G1*, *G2* and *G3* means management, shareholder, and CSR strategy scores. *ROA* is return on assets*; ROE* is return on equity; *lnMVC* is the logarithm of market value for company; *P* is the price to close; *Beta* is CAPM beta and *Sharpe* is the Sharpe ratio value.

3.2 ESG index construct

We respond to one of the problems that very often underlay the selection of the most appropriate ESG measure through our ESG-company index that constituted the exogenous variable of our analysis as a proxy of CSR activities. The ESG index was operationalized following Henseler (2017), who considered that the concept of an artifact is any construct designed by the human mind, representing a theoretical thought made up of elementary components that define it. They are called design constructs. The literature conventionally assumes that CSR comprises three elements or component parts, in our case, the Environmental, Social and Governance pillars. In this line, we scaled the constructs of this study as composite variables.

Table 3 shows the data related to the ESG variables used as dimensions of the ESG index design construct. The three Environmental, Social, and Governance pillars include ten categories which in turn are integrated by a set of items from the Eikon database.

Table 3. Variables ESG used in the analysis.

Variables	Definition	Items
Resource use (E1)	Resource use variable highlights a company's performance and capacity to reduce the use of materials, energy or water and to find eco-efficient solutions by improving supply chain management	water and energy efficiency policies; environmental management systems; total energy and water use; renewable energy use ratio; green buildings; and supply chain management and monitoring
Emissions (E2)	The emission reduction variable reflects the company's commitment and effectiveness in reducing environmental emission in the production and operational processes	emission policies and targets; total CO_2 emissions; indirect and Scope 3 emissions to revenues; climate change opportunities; waste management; e-waste reduction; environmental restoration; staff transportation impact reduction; environmental expenditures and revenues
Environmental innovation (E3)	The environmental innovation variable reflects a company's capacity to reduce the environmental costs and aims to create new market opportunities through new environmental technologies and processes or eco-designed products	environmental project financing; environmental products; environmental assets under management; Equator principles; and clean energy products
Workforce (S1)	The work variable measures a company's effectiveness towards job satisfaction, healthy and safe workplaces, maintaining the diversity and equal opportunities and development opportunities for its workforce	health and safety policy; training and development policy; diversity; equal opportunities; salary gaps; turnover of employees; and flexible working hours
Human rights (S2)	The human rights variable measures a company's effectiveness towards respecting fundamental human rights conventions	freedom of association; child labor; and human rights
Community (S3)	The community variable measures a company's commitment towards being a good citizen, protecting public health and respecting business ethics	fair competition; bribery; corruption; business ethics; community involvement; and community lending
Product responsibility (S4)	The product responsibility variable reflects a company's capacity to produce quality goods and services integrating the customer's health and safety, integrity and data privacy	data privacy (especially the General Data Protection Regulation); customer satisfaction; and quality management systems
Management (G1)	The management variable measures a company's commitment and effectiveness towards following the best corporate governance principles	corporate boards; compensation; the nomination committee and its independence; CEO-chairperson separation; remuneration packages linked to the total shareholder's return; the succession plan; internal audit; external consultants, and audit committee independence
Shareholders (G2)	The shareholder variable measures a company's effectiveness towards the equal	equal shareholders rights and specific policies; voting cap

	treatment of shareholders and the use of anti-takeover devices	percentage; shareholders vote on executive pay; director election majority requirement; veto power or golden shares; anti-takeover devices; non-audit to audit fees ratio, and auditor tenure
CSR strategy (G3)	The CSR strategy variable reflects a company's practices to communicate, in which it integrates the economic (financial), social and environmental dimensions into its day-to-day decision-making processes	existence of the CSR sustainability committee; stakeholder engagement; CSR sustainability reporting, and external audit

Source: based on Batae et al. (2021), and Ting et al. (2020).

Designing CSR as a multidimensional construct means we conceptualize it as a variable that only exists to the extent that its subdimensions are present. With the advancement of research on CSR, unidimensional and multidimensional conceptualizations of the concept have been reached. However, considering CSR as a multidimensional rather than a one-dimensional construct requires a separate scope and measurement models (Bollen, 2011).

A construct is described as multidimensional (higher – order construct) when its indicators are themselves latent constructs (dimensions) (Polites et al., 2012). A multidimensional construct refers to several related but distinct dimensions treated as a single theoretical concept (Edwards, 2001). Each dimension represents a single content domain, and they are latent variables (lower – order constructs) inferred through their observable variables (indicators).

Namely, in our case, the Environmental, Social and Governance dimensions added as an exact linear combination leads to the formation of the design construct that we call the ESG index. In that way, we avoid subjective assignments in calculating the ESG index in accordance with previous literature (Callan & Thomas, 2009; Gyönyörová et al., 2021) that considered these weights inadequate. Therefore, we did not use the weighted ESG score provided by the data provider Eikon, but we built our own ESG index. The ESG index falls within the aggregate multidimensional construct typology, that is, it is a composite of its dimensions, which means that the dimensions are combined to produce the construct, with a causal relationship (Edwards, 2001). Our model that directly estimates dimension weights is captured by the following equation:

$$\eta = \sum \gamma_i \xi_i \quad (1)$$

where,

η = higher-order construct or aggregate construct

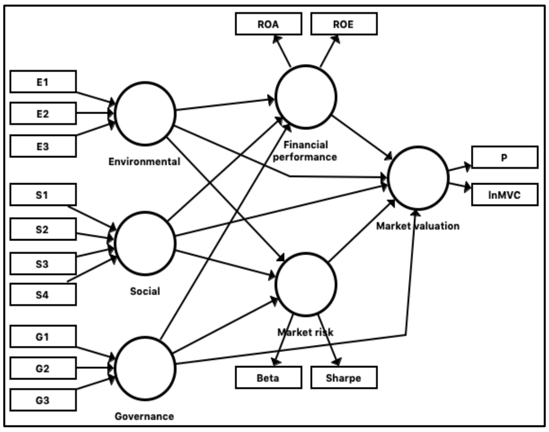
γ_i= dimension weights

ξ_i= dimension or lower-order constructs

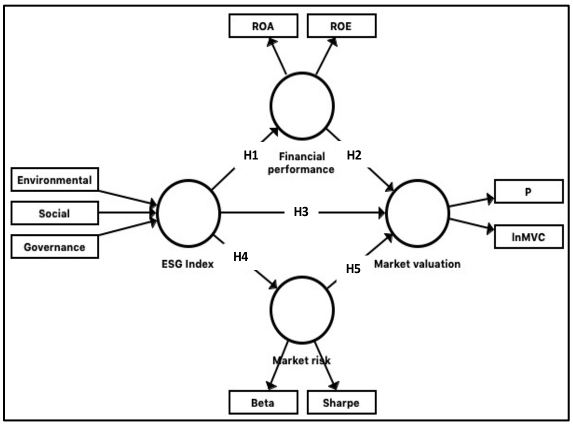
Equation (1) of the aggregate construct represents the relationships with its dimensions by estimating the weights as free parameters within the model itself. Additionally, we are dealing with a study of a single industry of activity, so that the problem of commensurability pointed out by Capelle-Blancard & Petit (2017) did not apply in our case.

3.3 PLS – SEM Analysis

The analytical approach employed in this study was Partial Least Square Structural Equation Modeling (PLS-SEM) (Chin, 1998; Wold, 1980). The program SmartPLS 3.3.3 (Ringle et al., 2015) was used, drawing the models shown in Figure 2. The program also allows testing second-order structures using hierarchical component models that combined higher order constructs (HOCs) and lower order constructs (LOCs).



(**a**) Lower – order model



(**b**) Higher – order model

Figure 2. The theoretical model of the hierarchical component nomogram is compound by (a) the Lower – order model; (b) the Higher – order model.

PLS-SEM allows the design of models, represented graphically by nomograms, where the relationships between unobserved variables, called latent variables or constructs (ellipses), and their indicators (rectangles) are simultaneously tested. Likewise, the structural hypotheses (*Hi*) are to be contrasted between different latent variables. Thus, two statistical traditions are used in combination. On the one hand, factor analysis where a factor variable (latent variable or construct in PLS-SEM) is defined by *p* communal variables (indicators or items in PLS-SEM) so that the latent variable can explain the shared content of the *p* original variables. On the other hand, linear regression analysis, where the behavior of a variable (endogenous, explained, or dependent) is explained using the information provided by the values taken by a set of explanatory variables (exogenous or independent).

The PLS-SEM algorithm sequence in the first place evaluated the measurement model. This step tested the criteria of individual item reliability, construct reliability, convergent validity, and discriminant validity for constructs in mode A. For its part, if the latent variable is defined as mode B or formative, the criteria to be validated were multicollinearity between indicators and the significance and relevance of the weights of each indicator (Hair et al., 2019).

In a second place, we evaluated the structural model. Once the reliability and validity of the measurement models have been verified in the previous stage, asses of the structural model will test the fulfillment of the hypotheses and the predictive power of the complete model. In this sense, the criteria to be considered have to do with predictive validity (Q^2), size of effects (f^2), and coefficients of determination (R^2).

The use of PLS-SEM has the potential advantage of being able to scale as composite variables to those that represent a theoretical thought designed as an artifact composed of elementary items that define it. What is known under the name of "design-construct" (Henseler et al., 2014; Henseler, 2017). Precisely, we have considered the ESG index variable a design construct composed of three dimensions (Environmental, Social and Governance) created in this way for research purposes as we have explained above. In our case, we designed ESG index as a higher – order construct. Furthermore, we have defined the ESG index variable as a formative type according to Polites et al. (2012).

Using the two-step approach (Hair et al., 2017), we went from a LOC model to a more parsimonious HOC model. For this procedure, we used the scores of environmental, social and governance as indicators of the higher – order ESG index construct (Ringle et al., 2020). When we analyze models with lower – order constructs and higher – order constructs, the analysis of components in PLS-SEM allows the calculation of scores of latent variables as an exact linear combination of the indicators, adding them in constructs of order higher (Chin, 1998; Richter et al., 2016). Considering the ESG index as an aggregate of its dimensions is a specific contribution of this work concerning others that only consider first-level structures of this variable.

4. Results

In this section, we present results for predicting market value through the incidence of ESG index, financial performance, and market risk for O&G companies.

Figure 3 shows the nomogram graph of this empirical application. This figure reveals three antecedent explanatory constructs (environmental, social and governance–ESG index; financial performance–FP; and market risk–MR) that predicted the endogenous variable (market value–MV). Since the exogenous variable, ESG index, was a composite measured in mode formative through higher – order component, the magnitudes of the individual coefficients (E, S, and G) correspond to their relative importance.

4.1 Assessment of LOC measurement model

The lower – order constructs measurement model constitutes the first stage in the two-step approach of the PLS – SEM algorithm for higher – order models. Thus, it is tested compliance with the measurement scales whether the model of indicator-construct relationships was both in A-reflective mode or B-formative mode.

On the one hand, to test the individual item's reliability of measurement in mode A or reflective, all the indicators of the LOCs in mode A (financial performance, market risk, and market value) presented loads higher than the threshold value of 0.707, and it was not necessary to eliminate any of them. That is, the variation of the items due to the construct was statistically significant, validating the commonality of the indicators.

The internal consistency reliability of the indicators was measured by the composite reliability that reached values above the threshold of 0.7 (see Table 4). For its part, the convergent validity through the AVE gave values greater than 0.5, meaning that the construct explained more than half of the variance of its indicators, as seen in Table 4. Therefore, the two criteria were met.

Table 4. Construct reliability and convergent validity LOC.

Constructs	Composite Reliability	AVE
Financial performance	0.827	0.709
Market risk	0.740	0.594
Market value	0.762	0.632

Source: Own elaboration.

Discriminant validity analysis indicated the degree to which the constructs differed and were met through Fornell and Larcker criterion (see Table 5), where the square root of the AVE values of each construct (in bold) was higher than its correlations with the rest of the constructs.

Table 5. Fornell and Larcker criterion LOC.

Constructs	E	FP	G	MR	MV
Environmental	**n/a**				
Financial performance	0.325	**0.842**			
Governance	0.653	0.255	**n/a**		
Market risk	-0.367	-0.417	-0.169	**0.771**	
Market value	0.624	0.380	0.509	0.233	**0.795**

Source: Own elaboration.

On the other hand, the measurement of mode B indicators' LOC multicollinearity problems were detected for indicator *E2. Emissions score* of the lower – order construct environment and, consequently, it was eliminated from the model. Specifically, it presented a variance inflation factor (VIF) value above the threshold of 3.3 (see Table 6).

Table 6. Variance inflation factor

Variables	VIF
E1	3.72
E2	3.82
E3	1.35
S1	2.26
S2	1.72
S3	1.63
S4	1.61
G1	1.32
G2	1.20
G3	1.14

Source: Own elaboration.

After we eliminated the multicollinear indicator *E2* from the B-mode measurement models, we applied the structural equation modeling algorithm again. It was verified that the formative constructs E, S, and G were reliable and valid.

4.2 Assessment of HOC measurement model

Once the LOC's measurement models (both reflective and formative) were validated in the first stage of the two-step approach, obtained the scores of the Environmental, Social and Governance dimensions. They were then used as indicators of the higher – order construct obtaining the ESG index as an exact linear combination. Next, we present the evaluation of the criteria to know the reliability and validity of the higher – order model measurement scale.

Since the second-order construct (ESG index) is measured in formative mode or B, we tested for multicollinearity problems detected for the social indicator and eliminated it from the model. Specifically, it presented a VIF value (3.644) above the threshold of 3.3. Once the social indicator was removed from the model, the problem was solved.

Concerning significance and relevance, the analysis of the formative construct in mode B, ESG index, showed that the indicator with the most significant weight was the Environmental dimension (0.898) and significative (0.000). Secondly, although the governance indicator had less importance in forming the ESG index, it also presented significance. Although the p-value is higher than 0.05, however, its loading value was higher than 0.5, and in such cases, it is considered that the weight is significant and supplied content validity to the model (see Table 7).

Table 7. Significance of weights.

	Original Sample	*t*	loadings	*p*	Lo95	Hi95
ESG index						
Environmental	0.898	10.762	0.994	0.000	[0.754	1.029]
Governance	0.147	1.303	0.733	0.096	[-0.046	0.328]

*: p<0.05; **p<0.01; ***p<0.001.
Significance, t statistic, and 95% bias-corrected confidence interval performed by 5,000 res. boot-strapping procedure.

Therefore, the more significant and more positive the activities and procedures related to the Environmental dimension of energy companies, the more the ESG index improves. In addition, when monitoring systems about governance are implemented, the ESG index improves, although the weight or impact is somewhat lower than for the Environmental dimension.

4.3 Assessment of HOC structural model

After showing the reliability and validity of the measurement scale by above-evaluating the measurement model, the PLS-SEM proceeded to assess the predictive power of the HOC model, and the structural relationships model hypothesized.

Figure 3 illustrates the nomogram of relationships between constructs of the HOC model, and Table 5 gives the calculated path coefficients and significance levels of the hypotheses. Furthermore, Table 5 indicates that latent variables' VIF fluctuated between 1.000 to 1.282, implying multicollinearity was not a concern.

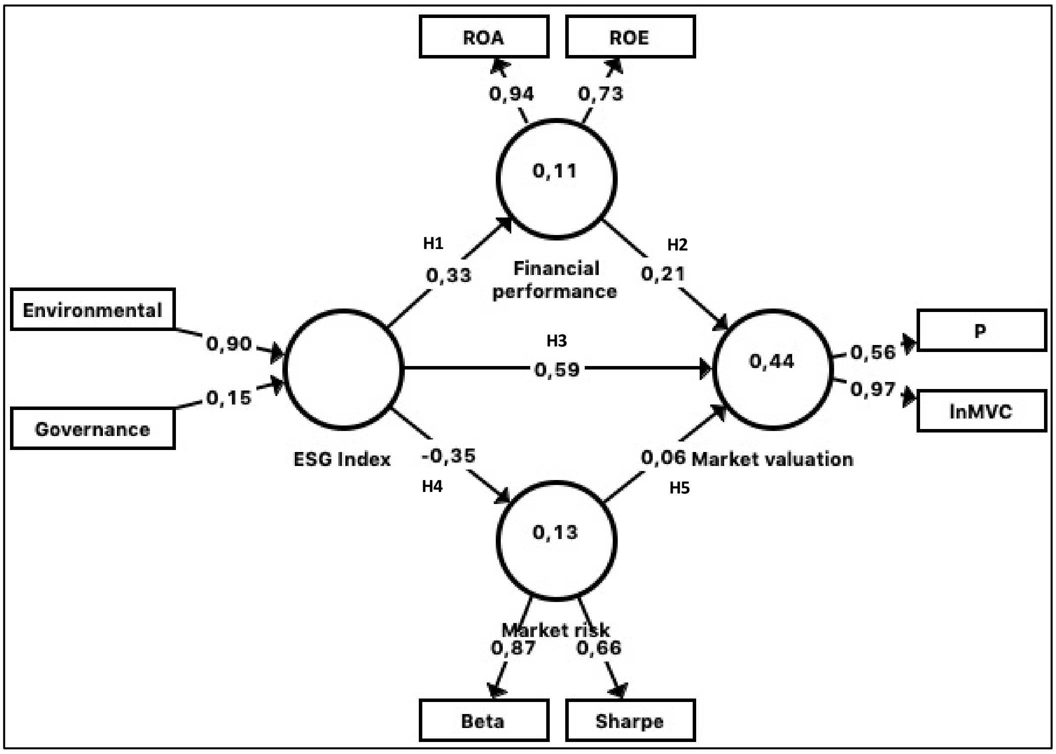


Figure 3. Higher – order final model results.

Figure 3 and Table 8 show all the hypotheses analyzed in the present study were supported and gave well-defined prediction signals except for H_5 (market risk → market value). Through the blindfolding procedure, the measurement of the Stone-Geisser Q^2 value (Geisser, 1974; Stone, 1974) indicated the predictive relevance outside the sample, presenting values more significant than threshold zero (see Table 8).

The coefficients of determination R^2 showed the predictive power of the model. The value of R^2 represents the amount of variance explained by the antecedent constructs associated with an endogenous construct. The predictive level of the constructs financial performance and market risk with R^2 0.11 and 0.13 respectively were adequate, according to Falk and Miller (1992). They suggest at least a value greater than or equal to 0.10. In the case of the construct market value, with an R^2 value of 0.44, its level is more than moderate. The contribution was 37.3% of the ESG index and 8% of the financial performance (see Table 9).

The effect size (f^2) assesses the degree to which an exogenous construct helps to explain a given endogenous construct in terms of R^2 (Cohen, 1988). A heuristic rule of Cohen (1988) to evaluate f^2 maintains that: $0.02 \leq f^2 < 0.15$, it is a small effect; $0.15 \leq f^2 < 0.35$ is a moderate effect and $f^2 \geq 0.35$ is a large effect. In this vein, the results show that the size of the effect between the ESG index exogenous construct and its degree of contribution to the market value endogenous construct (0.513) is significant, presenting a large effect.

Concerning the hypotheses tested, financial performance and the ESG index had a positive and significant impact on market value (path = 0.211, p = 0.000, and path = 0.588, p = 0.000, respectively); hence, H_2 and H_3 were supported. Furthermore, the direct effects between the ESG index on financial performance and market risk had a positive/negative and significant impact (path = 0.329, p = 0.000, and path = –0.354, p = 0.000, respectively); therefore, H_1 and H_4 were supported as well. Finally, hypothesis five was rejected because of its lack of significance (path = 0.063, p = 0.223).

Table 8. Whole Sample Results.

	Path	*t*	*p*	Lo95	Hi95	f^2	VIF
Direct effects							
ESG → MV	0.588***	13.087	0.000	[0.514	0.662]	0.513	1.199
FP → MV	0.211***	3.688	0.000	[0.114	0.302]	0.063	1.257
MR → MV	0.063^{ns}	1.187	0.118	[-0.032	0.142]	0.005	1.282
R^2: 0,44; Q^2: 0.237							
ESG → FP	0.329***	7.376	0.000	[0.260	0.406]	0.121	1.000
R^2: 0.11; Q^2: 0.069							
ESG → MR	-0.354***	6.855	0.000	[-0.444	- 0.273]	0.143	1.000
R^2: 0.13; Q^2: 0.065							
Indirect effect						**VAF**	
ESG → FP → MV	0.070***	3.348	0.000	[0.036	0.105]	0.105	n/a
ESG → MR→ MV	-0.022^{ns}	1.127	0.130	[-0.054	0.011]	ns	n/a

*: p<0.05; **p<0.01; ***p<0.001.
Significance, t statistic, and 95% bias-corrected confidence interval performed by 5,000 res. boot-strapping procedure. VIF: Inner model Variance Inflation Factor. VAF: Variance Accounted for. n/a: not applicable

In short, data seem to show that higher commitments about sustainability, such as reported by the ESG index, increased companies' financial returns and values in the market. Meanwhile, the greater ESG rating reduced market risk. Similarly, the financial performance had a significant positive influence on fundamental analysis of the value of companies. Therefore, these results can help managers to design or define the corporate value creation strategy.

Table 9. Determination coefficient decomposition

Dependent variable	*R* square	Antecedents	Path	Correlations	Explained variance*
Market valuation	0.44				
		Financial perf.	0.211	0.379	8.0%
		ESG index	0.588	0.635	37.3%
		Market risk	0.063	-0.231	-1.5%

* Explained variance: path coefficients × correlations

In addition to values of direct effect, Table 8 also illustrated indirect effects. The mediation analysis indicated that the ESG index affects market value directly and indirectly through financial performance, which worked as a mediating variable in the model. Moreover, the value of the variance accounted for (VAF) implied that the measurement was partial with a percentage of 10.5% (see Table 8).

5. Discussion

This research adds to evidence that ESG practices positively impact market value in the energy industry for O&G companies. Obviously, findings support for incorporating robust favorable ESG profiles to develop the corporate finance strategy. It appears that markets are influenced by the level of companies' ESG ratings when performing about environmental and governance issues, thereby supporting Miralles-Quirós et al. (2019); Shakil (2021); Shanaev & Ghimire (2021) studies. Results shows that Environmental and Governance dimensions are the factors that conform the ESG index that will be higher when they are both high. Based on this result, companies may consider sustainability management when assessing how the market responds to their ads. Moreover, there was a significant effect size for the ESG index, suggesting that the incorporation of ESG profile appeared to have a strong influence on the markets when they evaluated the value of a corporation. These findings are intuitively appealing because the CEOs are probably more closely associated with the fundamental analysis, and the shareholders are more closely associated with sustainability ratings. The results indicate that companies should consider the three dimensions determine its performance. Still, even if highly significant, the impact of the Governance will not be as important as the Environmental dimension when assessing the environmental, social and governance performance. Our findings are in line with Tzouvanas & Mamatzakis (2021), which found a positive relationship between environment score and market value. Furthermore, we subtianted that the social score has not influenced, while governance has a positive influence. Therefore, whereas the stakeholders may want to be aware of the impact that the fundamental analysis can have on the value of a company when it comes to corporate financial strategy, the commitment to the corporation's sustainability, through the ESG index, appears to play a more significant role.

This study also indicates that financial performance is significantly more important than market risk in determining the market value. Thus, although both play a role in the relation risk-return (Bodhanwala & Bodhanwala, 2020; Tzouvanas & Mamatzakis, 2021), the market risk has considerably less impact when valuing the energy industry. Perhaps the market risk was not significant for market valuation because the ESG index recognizes the energy industry risk factor instead. It could be that the ESG index is more highly involved in the evaluation of the general risks of the O&G industry, primarily by environmental issues, than the market risk. Therefore, the impact of the market volatility would have a more negligible effect on market value. Additionally, there is some evidence that for many stakeholders, the impact of sustainable profile is relevant to assessing a company's value and does not serve only as a peripheral signal (Champagne et al., 2021). This circumstance is particularly true if the company is highly involved with environmental business issues such as the energy industry and other sensitive industries (Alda, 2021; Radhouane et al., 2020).

According to Lins et al. (2017), disclosure on sustainability appears to influence financial performance in the company, which in turn affects their reputation and legitimacy. Even if the company's financial performance is weak, the reputation of the company may make stakeholders feel more confident and make them significantly more willing to engage with the company. In addition, our results indicate that the ESG index plays a larger role in corporate financial performance. This can be explained by the higher weighting of Environmental and Governance dimensions than Social. By using compelling environmental strategy that drives ESG ratings, O&G companies can produce better financial results using the legitimacy paradigm. This observation was previously made by López-Toro et al. (2021) for the pharmaceutical industry, who showed that investing in environmental, social, and governance initiatives enhances the visibility and profitability of the industry or Miroshnychenko et al. (2017) who indicated that internal green practices are the main environmental drivers of financial performance.

Our study found a negative and significant association between ESG profile and systematic risk, demonstrating that the higher the ESG rating, the lower the market risk in the O&G industry. According to this finding, previous research has claimed that ESG performance is inversely related to market risk, as reported by Dilling & Harris (2018) and Shakil (2021). The commitment of O&G companies to environmental and governance policies, coupled with the respect they show for energy transition, allows them to reduce risk and become good companies. In this way, companies' commitment to ESG policies can lower risk while it can serve as a hedge for higher market valuations. However, the last assumption was not found in our study. It may be because the relationship between market risk and the value of the company should not be defined directly, but rather as a moderating effect between financial performance and market value.

6. Conclusions and implications

As part of their CSR efforts, companies hope to increase their market value. In previous studies of ESG scores within the O&G industry, a single factor is linked to the ESG variable. This research unlike previous studies looks at multiple variables that companies' ESG strategies may impact constructing a more comprehensive corporate finance system. In this more comprehensive approach, information is provided on how ESG attributes affect variables such as market risk, financial performance, and market value, which in turn is influenced by financial performance and market risk, completing the complex relationship system. Therefore, the purpose of this study has been to identify all the potential relationships between the ESG index and the determinants of corporate financial strategy simultaneously: ESG-financial performance, ESG-market risk, and ESG-market value. ESG index become even more important when we consider an industry such as O&G, which has a profound impact on the environment. This research contributes to the proposed objective by evaluating the ability of the ESG index, financial performance, and market risk to explain the market value in the O&G industry worldwide. Through our obtained results we can identify possible strategies that could be implemented within the governmental and business frameworks to reduce the social and environmental impact of the O&G industry.

O&G companies should adopt ESG practices that increase their market valuation, reduce their risks, and positively impact their financial performance. By emphasizing the component elements of the ESG index, managers can also develop an overall corporate finance strategy for their shareholders by gaining insight into how the Environmental and Governance dimensions affect the variables under investigation. Thereby, higher levels of the ESG index, in particular, the contribution of the Environmental dimension, benefit the market value of companies. Consequently, more efficient use of resources must be required in the value chain of companies when extracting oil and gas, accompanied by more significant investments in environmental innovations. Simultaneously, within the Governance dimension, agency theory is involved. In this vein, the objectives managers should coincide with those of the shareholders through the implementation of mechanisms such as management and supervision of boards, sustainability incentives, shareholders vote on executive pay, equal shareholders rights or the disclosure of CSR sustainability reporting. All this will not only reduce the negative environmental impact of these companies but will also improve their economic and financial performance and their market value considering the obtained results. Furthermore, investors began using ESG indices as a tool to determine potential risks that may result from environmental issues with even greater importance than the weight, they gave to market risk in the selection of portfolios. Additionally, the negative association between ESG and market risk brought to the forefront that we can consider the ESG index as a valid measure in financial risk management. Against this background, governments must begin to implement policies and regulations that allow O&G companies to improve their environmental and social performance within the framework of an energy transition.

Therefore, the findings indicated that the O&G industry might be motivated to adopt environmentally and socially responsible practices that result in corporate finance aligned with the demands of its investors. The agency theory supports this implication for improving the performance of the investment portfolio. Reducing the negative impact that some practices have on the environment and society translated into benefits in terms of financial return, risk, or market value. Consequently, international policy and regulation should pay more attention to the analysis and quantification of the dimensions of the ESG index to ensure a higher quality of CSR engagement in companies.

The present work has some limitations that should be pointed out to adopt future lines of research. The sample used has been selected for a single year. Although the data are current, a longer period would provide more information about the relationships tested, and thus would reaffirm or reject the results obtained. Secondly, it is a industrial study, focusing on multinational O&G companies. The results should not be extended to other energy industry companies, such as renewable energy, for example. Additionally, since it is a global sample, the results might be affected by specific policy and legal factors in each country or region. Also, in line with the study of the effects of ESG factors on global corporate financial strategy, one of the limitations of this analysis is not to include a possible moderating effect of ESGC on the relationship between both variables.

However, future research can be based on the model designed for this research which related the ESG index with the global corporate finance strategy. A broader industrial sample within the energy mega industry will allow us to identify and make a comparative analysis that helps to discriminate the performance of the ESG index between renewable and non-renewable energy companies. Expanding the sample over time and carrying out a study by periods will also identify the impact of economic crises on the relationships (2008 crisis, Covid – 19 crisis, for example). Also, the features of the board and the gender effect will be variables that could have a high impact on the market value within the energy industry. Finally, and considering the last limitation mentioned in the previous paragraph, we thought it convenient to introduce the moderating variable ESGC in the model exposed in this Chapter. In Chapter 3 of the thesis, we will put an end to this limitation with the study of a model that will allow us to know whether there is a moderating effect on the ESG – corporate financial strategy link or not.

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CHAPTER III. IMPACT OF THE ESG CONTROVERSIES ON THE RELATIONSHIP BETWEEN CSR MANAGEMENT AND CORPORATE FINANCIAL PERFORMANCE IN THE GLOBAL OIL AND GAS INDUSTRY

DO ESG CONTROVERSIES MODERATE THE RELATIONSHIP BETWEEN CSR AND CORPORATE FINANCIAL PERFORMANCE IN OIL AND GAS FIRMS?

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DO ESG CONTROVERSIES MODERATE THE RELATIONSHIP BETWEEN CSR AND CORPORATE FINANCIAL PERFORMANCE IN OIL AND GAS FIRMS?

Abstract

The O&G industry is enmeshed in a continuous debate regarding the negative impact that its activity has on the sustainability of the environment. Increasingly, the market and stakeholders are positively evaluating those companies which are socially responsible and penalizing those that are not. Literature has analyzed the market view through the Environmental, Social and Governance (ESG) controversies and their relationship with Corporate Financial Performance (CFP), as well as with Corporate Social Responsibility (CSR) strategy.

This study analyzes the influence of ESG Controversies as a moderating variable on the relationship between Environmental, Social, and Governance factors and Corporate Financial Performance from a market valuation perspective. To perform this analysis, PLS-SEM structural equations have been applied to a sample of 264 oil and gas companies globally.

The results confirm the moderating influence of ESG controversies on the relationship between E, S, and G factors and Corporate Financial Performance.

Keywords: ESG, financial performance, ESGC, market value, oil and gas

1. Introduction

Corporate Social Responsibility (hereinafter, CSR) is becoming an increasing priority for the competitive strategy of companies. The reputation and vision that the market has of companies regarding the level of CSR are dominant issues today when evaluating market value or Corporate Financial Performance (hereinafter, CFP). Given the importance of this area, major institutions, such as the United Nations (2015) have urged companies to undertake responsible practices to achieve certain goals aimed at improving the environment and society. Actions related to the intention of safeguarding the environment, contributing to an improvement in workers' labor rights, or gender equality in the corporate governance of companies, have put some companies under pressure to carry out changes within its strategy throughout the globe. The market has the opportunity to bring under consideration actions that can contribute to improving the environment, gender equality or workers' rights (Lu & Wang, 2021). As a result of this process, Environmental, Social and Governance (hereinafter, ESG) factors have allowed companies to disseminate their responsible practices throughout the entire market. Also, non-responsible practices affecting certain companies could also be assessed through a market lens by means of ESG Controversies (hereinafter, ESGC). In recent years, we have witnessed a great debate around ESG/ESGC factors, which has allowed us to find out in more detail how the ESG/ESGC index is built and its contribution to the CFP of companies in certain industries (Gyönyörová et al., 2021).

Due to the increased awareness regarding the consequences of certain market practices, controversial industries such as energy have been forced to adopt measures to reduce their impact. In recent years, society has witnessed how climate change is becoming a real challenge for the Earth with, for example, rising temperatures and increased rainfall levels. In particular, the Oil and Gas (hereinafter, O&G) industry has found itself in the spotlight of activists and government institutions which are trying to raise awareness and reduce the negative impact of this industry (Boudet et al., 2014). For example, the fracking activity, one of the most environmentally damaging extraction practices, has been the issue of constant criticism due to the high impact it has on the soil and water consumption (Brantley et al., 2014). Evidently, the O&G industry deserves to be analyzed in detail. According to the International Energy Agency (2021), 62% of CO_2 emissions come from O&G companies. Moreover, 56% of the total energy consumed globally is sourced from oil, gas, coal, and derivatives, being considered one of the largest contributors to the increase in global warming (British Petroleum, 2021). Therefore, reducing emissions and achieving greater efficiency in the use of natural resources are two fundamental priorities of governments and institutions. Initiatives such as the 2030 Agenda (United Nations, 2015) or the Sustainable Development Goals of the European Union (Publications Office of the European Union, 2021), are, to some extent, behind O&G companies' commitment to reducing the impact of certain activities within their structure.

Not only are there compliance issues, but CSR has become a relevant factor for the economic-financial valuation of companies and investments by the market (Paolone et al., 2021). Reporting on ESG factors in the O&G industry has become a key issue for the market, due to the severe negative impact of its activity, especially regarding environmentally responsible performance. Thus, the importance given by the market to ESG factors, has led to market and social punishment of bad practices at the social or environmental level. According to Bodhanwala & Bodhanwala (2020), the market tends to invest in environmentally responsible companies, as opposed to those that carry out bad practices, the ESGC. This concept includes news about companies relating to fraudulent activities, scandals to do with products or legal problems with certain institutions (Tamayo-Torres et al., 2019). Refinitiv (2021) defines ESGC as a company's exposure to negative events in the global media. Due to its negative character, previous studies have purported that a greater number of negative events leads to an increase in market volatility for certain industries, thereby contributing to an increase in risk for the market value (Aboud & Diab 2019; De Franco, 2020). This volatility can be totally or partially alleviated by increasing responsible practices in terms of ESG factors (Aboud & Diab, 2018). Therefore, ESGC could act as a moderator of the effect of ESG factors on the CFP of O&G companies by lessening the relationship between both.

ESG factors have ceased to be a simple unit of measurement and their management has become a pillar of great importance in the development of companies' corporate strategy. Previous studies have shown that stakeholders place greater emphasis on companies meeting social and sustainability objectives which enable them to access new financial resources and so create greater market value (Nirino et al., 2021). Authors such as Borralho et al. (2022) confirm that ESG disclosure alleviates information opacity and improves its transparency.

Stakeholder theory and legitimacy theory can explain the nexus between ESG factors and their relationship to CFP. Stakeholders' theory supports the increase in the market value of the company, which contributes to the increase in the wealth of shareholders and produces a call effect propitiated by the success because of this strategy (Freeman & McVea, 2005). Further, the theory of legitimacy endorses the influence that ESGC have on volatility and market value. An increase in this factor diminishes the company's reputation which could result in price volatility reaching historic highs (Alda, 2021). Thus, as seen in the previous literature, there exists evidence that ESG factors could influence the CFP of the company, and that ESGC could contribute to moderating this relationship (Rodríguez-Fernández et al., 2019; López-Toro et al., 2021).

However, part of the previous literature relating to ESG factors focuses on specific aspects of the index such as the diversity of gender in corporate government (Terjesen et al., 2016), product design (Chaiyapa et al., 2018) or human rights (Pegg, 2012). Despite the O&G industry being one of the most important contributors to the global economy (International Energy Agency, 2021) previous studies have tended to focus only on one factor that explains CFP, this being risk, measured by market volatility (Champagne et al., 2021). Regarding the moderating effect of ESGC in the O&G industry, to the extent of our knowledge, the article by Shakil (2021) is the only example to date. This article studies the moderating effect of ESGC on the relationship between ESG factors and financial risk. This partial vision of the influence of ESG factors as well as ESGC that have an impact on CFP and the company value of the O&G industry, indicate an interesting research gap that we endeavor to fill and lend a more complete and global view to.

Thus, the main objective of this paper is to analyze whether ESGC have a moderating effect on the relationship between ESG factors and CFP in the O&G industry. To this end, first the link between ESG factors and CFP is analyzed. Regarding these two objectives, the article raises two research questions: to what extent do ESG factors affect CFP? Do ESGC influence the relationship between ESG factors and CFP?

After reviewing the previous literature, we have provided a global sample made up of 264 companies involved in the O&G industry. The sample collects information from 2019 and for ESGC from 2018. The data has been extracted from the Thomson Reuters Eikon database (Refinitiv, 2021). The analytical approach used in this study was the

Partial Least Squares – Structural Equation Modeling (PLS-SEM) (Wold, 1982; Chin, 1998).

The results support a significant and positive relationship between Environmental and Social factors and the CFP of O&G companies. Regarding the main objective, the results confirm that ESGC have a moderating effect in the relationship between ESG factors and CFP. An increase in bad news results in this relationship being weaker. On the other hand, reduced values of ESGC tend to strengthen the relationship. Results show that a one standard deviation increase in ESGC for an average company reduced the relationship between Environmental and Social factors and CFP by 16.26% and 52%, respectively. Results also show that ESGC negatively affects CFP.

The structure of this paper continues as follows. In Section 2, a literature review is detailed according to the research hypotheses. Section 3 present the data and the methodology used. The results are set out in detail in Section 4. Discussion and conclusions can be found in Sections 5.

2. Literature review

The literature on sustainability or CSR has substantially evolved over the last few years, although one of the most debated issues that constitute the core of this line of research is that relating to the effectiveness of sustainability policies (Sarkis et al., 2011; Wang & Sarkis, 2013). In this vein, the work carried out has tried to measure the influence of ESGC on the relationship between ESG factors and CFP and the impact that the ESG factors have on CFP through the win-win approach and Elkington's Triple Button Line theory (Elkington, 1998).

2.1 Relationship between the Environmental factor and CFP

The Environmental factor encompasses everything related to environmental protection, climate change awareness, efficient use of natural resources, waste management and pollution emissions, among other issues (Brogi & Lagasio, 2019).

Practices aimed at conserving and reducing environmental impact can have short and long-term benefits in any organization (Reinhardt, 1999). In the short-term they produces some advantages, such as the reduction of costs and waste that eco-efficiency can entail and the reduction of penalties for non-compliance (Reinhardt, 1999; Siegel, 2010; Tamayo-Torres et al., 2019). They may also lead to the possibility of exploiting new markets and regions, with the consequent increase in revenues (Reinhardt, 1999). In the long term, these practices involve the creation of corporate image and reputation, thus reducing uncertainty and the negative effect of environmental accidents on the market value of the company (Godfrey et al., 2009; Doh et al., 2010; Ding et al., 2016; Tamayo-Torres et al., 2019; Flammer, 2021) while improving the relationship with various stakeholders, such as employees, customers and investors (Freeman, 1984; Delmas, 2001; Delmas & Montiel, 2008; Tamayo-Torres et al., 2019).

The analysis of the effectiveness of environmental policies and practices has focused on studying the impact on the market value of the company (Orlitzky et al., 2003; Brammer et al., 2006; Callan & Thomas, 2009), on financial performance (Siegel, 2010; Lai & Wong, 2012; Wang & Sarkis, 2013; Tamayo-Torres et al., 2019) or both (Ding et al., 2016; De Lucia et al., 2020). However, the results obtained are inconclusive.

Wang & Sarkis (2013) analyze the relationship between Environmental and Social factors with the supply chain and economic–financial performance, measured as Return on Assets (ROA) and Return on Equity (ROE), in a sample of 500 listed US companies. Their results show a negative relationship between the Environmental factor and profitability. Although, together with the social factor, the impact is positive.

Ding et al. (2016) with a sample of 44 listed companies in the construction industry in Australia, found that the companies with non-financial information indicators outperformed companies that did not show these indicators in some financial performance ratios or in their companies' market valuation, although correlation was not high. In this line, Tamayo-Torres et al. (2019) with a sample of 432 US and European companies, did not find a positive relationship between environmental indicators and financial performance, measured using the Tobin's Q ratio.

On the other hand, there are papers that find evidence of the positive impact of environmental policies on financial performance. Subrahmanya (2006) shows that companies with non-energy dependent activities achieve greater profitability than those which are energy dependent. Similarly, Bunse et al. (2011) show that energy efficiency improvement initiatives produce an increase in economic and financial performance indicators as well as an increase in productivity. Similarly, Fan et al. (2017) with a sample of energy-intensive companies from China demonstrated a positive relationship between energy efficiency and the financial performance indicators, ROE, and ROA. More recently, De Lucia et al. (2020), with a sample of 1038 European companies, found a positive relationship between environmental indicators of energy and water efficiency and ROA. The result of Garcia et al. (2017) in a sample of companies from industries with social impacts from Brazil, Russia, India, China, and South Africa is worth noting, showing a positive relationship between environmental performance indicators and financial profitability.

Considering this, following the literature above, the following hypothesis is proposed:

- *H_1: The Environmental factor positively impacts on CFP.*

2.2 Relationship between Social factor and CFP

The Social factor considers the relationships in the company regarding human resources, including ensuring stability in employment, guaranteeing health and safety, human rights, equal treatment, and the consideration of gender issues at all levels of the workforce (De Lucia et al., 2020).

Literature about the subject has tried to measure the Social factor effect on a company's financial performance or on its market value. Some research does not find a positive relationship between them (Margolis & Walsh, 2003; Margolis et al., 2009; Attig et al., 2013; Erhemjamts et al., 2013; Tamayo-Torres et al., 2019), although other studies show that the Social factor can lead to a company obtaining financial benefits. For example, a company can benefit from access to sources of financing, if investors appreciate the investment in social practices (Small & Zivin, 2005). Responsible investing is making great strides (Chatzitheodorou et al., 2019) and many investors may even elect to eschew investment in companies with bad social practices (Tamayo-Torres et al., 2019).

Furthermore, participation in social activities can lead the company to the development of new technologies that offer financial and social advantages over existing ones (Porter & Van der Linde, 1995; Tamayo-Torres et al., 2019). In addition, there may be a consumer valued competitive advantage to be gained over competitors (Baker & Sinkula, 2005). According to authors such as de Roeck & Delobbe (2012) and Raman (2018), the responsible management of social policies within the mining and petrochemical industry, respectively, contribute to greater worker retention and an improvement in the perception of companies. Social investment could even protect the reputation of organizations against the effect of negative events (Godfrey et al., 2009).

Thus, the following hypothesis can be established:

- *H_2: The Social factor positively impacts on CFP.*

2.3 Relationship between Governance factor and CFP

The Governance factor includes issues such as board independence, corruption and bribery, disclosure policy and shareholder protection (Galbreath, 2013) as well as heterogeneity in the board.

A more independent board (with fewer shareholders) may lead to certain improved CSR practices. For example, Velte et al. (2020) suggest that a non-shareholder board should encourage CSR practices in terms of emissions and environmental sustainability. Transparency and the publication of information in this regard can generate an increase in trust and therefore an improvement in financial performance. In the same way, Lueg et al. (2019) and Matsumura et al. (2014) suggest that an increase in transparency could reduce the information gap between shareholders and stakeholders, enabling an increase in transparency, a reduction in risk and an improvement in financial performance.

Decision-making by corporate governance can cause problems for the legitimacy of the company. An example of this is the financial fraud of Enron or the recent environmental scandal involving the automotive industry (Brand, 2016). Good corporate governance practices include the separation of the functions of CEO and Chairman of the Board or the diversity of board members (Galbreath, 2013). However, companies should not focus only on meeting shareholder expectations, but should also take into consideration all stakeholder groups to gain their support and ensure the long-term value of the company (Gjergji et al., 2021). In this way, greater trust, visibility, and reputation of the company will lead to greater competitiveness and greater financial performance (Beyer et al., 2010; Ng & Rezaee, 2015; Gjergji et al., 2021).

Several studies have empirically demonstrated that companies with high governance indicators lead to positive results. Thus, Niesten et al. (2017), highlight the role of collaboration and networks between the company and its stakeholders, as a mechanism to improve trust and, therefore, improve its performance. In this line, Husted

& Sousa-Filho (2017) emphasize the role of collaborative projects as an indicator of performance improvement compared to internally developed and outsourced projects.

In terms of gender and heterogeneity of the board, women tend to pay more attention to issues relating to environmental policies and CSR strategy (Balti & El, 2019). Through the market and investor lens, an increase in the number of women on the board could be considered an indication of equity and CSR, which in turn implies an increase in the market value of the company and in its financial performance (Amin et al., 2022; Bear & Post, 2010). Arayssi et al. (2016) analyze the role of female management on performance. With a sample of panel data between 2007 and 2012, they find that the presence of women on boards of directors positively affects performance. Others such as Valls & Rambaud (2019) also endorse this position for companies belonging to the Spanish stock market index IBEX35.

Good governance lies in avoiding decision-making that could harm the interests of the stakeholders. Stakeholders could influence financial performance through increased regulation or the cancellation of certain transactions, with senior executives or shareholders acting in their own right to challenge this stance (Busch et al., 2022; Hockerts, 2015). CSR strategy allows for a consensus between both parties to reduce the information gap (Dwyer et al., 2005).

In short, according to the previous literature, the Governance factor is positively related to the market value and financial performance of the company. Authors such as Tamayo-Torres et al. (2019) in their empirical study find that the Governance factor is positively related to Tobin's Q performance measure. Similar results are obtained in the work of De Lucia et al. (2020).

Therefore, the following hypothesis is proposed:

- *H_3: The Governance factor has a positive impact on CFP.*

2.4 Effect of ESGC on ESG – CFP link

Controversies are non-ethical practices such as the exploitation of labor, child labor, environmental pollution, business bribes or the use of illegal raw materials among others that lead to disagreements with stakeholders. In this vein, controversies are understood as conflicts generated with stakeholders due to the practices of the company and which negatively affect the ESG dimensions (Tamayo-Torres et al., 2019). For these bad practices to be evaluated by the market, the ESGGC index began to be used as a variable that measures the impact that these published negative events have on companies (Refinitiv, 2021). Such public data could undermine investor confidence and hinder the company's financial performance (Johnson, 2003). Following this negative impact, CSR strategy is becoming a strategy with which to restore market loss of confidence and to improve the reputation of the company (Becker-Olsen et al., 2006).

Controversies increase skepticism about the company, causing a deterioration in company credibility (Godfrey et al., 2009; Du et al., 2010; Aouadi & Marsat, 2018), due to increased awareness around issues related to sustainability (Diabat & Govindan, 2011; Adebanjo et al., 2016). Subsequently, the consequences of controversies may be a decrease in sales and an increase in risk and costs (Tamayo-Torres et al., 2019) and a negative impact on the value of the company (Aouadi & Marsat, 2018). Authors such as Nguyen & Nguyen (2015) argue that ESGC could negatively affect investor confidence and thus increase volatility and market risk in companies. Others such as DasGupta (2021) suggest that ESGC have a positive moderating effect on the relationship between financial performance and ESG practices. In line with these results, investors react negatively to bad news, especially if they are related to employees or the environment (Krüger, 2015).

The energy industry, particularly the O&G industry, experiences a high level of scrutiny by shareholders and society in general due to the negative impact on its operating activity (Bolton et al., 2011; Brantley et al., 2014). This negative impact can be reduced through an efficient CSR strategy, this being considered a good strategy to abolish the effects of ESGC (Dong & Xu, 2020). Indeed, ESGC management can moderate the relationship between ESG factors and the company's financial performance. In this sense, Shakil (2021) finds that ESGC moderate the relationship between ESG factors and financial risk for a set of 70 O&G companies. Others such as Nirino et al. 2021 find that, for a sample of European companies included in the STOXX Europe 600 index, ESGC negatively impact financial performance. In contrast, the moderating effect was not supported in this study.

In addition to the negative impact that certain practices have on the environment, particularly in the energy industry, the demand for ecological or environmentally friendly products has gained importance over the years (Altmann, 2015), leading companies to design strategies regarding the environment to meet the expectations of customers and stakeholders. The effect of the controversies would be a decrease in reputation and credibility, with the consequent negative effect on the relationship of environmental measures and financial performance. Indeed, investors are becoming increasingly concerned about irresponsible practices in certain industries leading to an interest in alternative business practices to reduce that impact. In the O&G industry case, the energy transition can be an example of these kinds of practices (Egli, 2020).

On the other hand, scandals related to Social and Governance factors would also lead to weakening the relationship between the measures carried out in these areas by the company and financial performance. Scandals such as Enron or Parmalat are examples of these kinds of practices (Engle, 2007).

Following the above, and considering that ESGC can affect one or more factors included in the ESG index, we establish the following hypotheses:

- *H_{4a}: ESGC moderate the relationship between the Environmental factor and CFP.*
- *H_{4b}: ESGC moderate the relationship between the Social factor and CFP.*
- *H_{4c}: ESGC moderate the relationship between the Governance factor and CFP.*

3. Materials and methodology

In this section we present the composite analysis carried out based on SEM (Yu et al., 2021) as an efficient optimization for defining relationship of the variables between ESG and CFP factors. In addition, we describe the two-step approach method that is appropriate when considering the construct ESGC as a moderating variable (Fassott et al., 2016).

3.1 Data and variables

The sample of O&G companies was made up of secondary data from the Eikon database of Thomson Reuters. Our final dataset consisted of 264 companies, with observations referred to measure the variable ESGC. We delayed controversies by 1 year, using the 2018 observations for ESGC and the 2019 observations for ESG and CFP factors. We delay ESGC by 1 year to allow time for the transmission of their effects to both CSR and financial performance (Callan & Thomas, 2009; Tamayo-

Torres et al., 2019).

Our model has five constructs, with the E, S and G pillars and ESGC being the four exogenous variables, expressing only CFP as an endogenous variable. We used pillars E, S, and G separately to test the relevance that CSR practices have on CFP based on indicators used in previous studies (López-Toro et al., 2021; Nirino et al., 2021). In the case of the ESGC variable we assume a negative relationship with CFP in line with previous studies (Tamayo-Torres et al., 2019; DasGupta, 2021).

The Environmental pillar was composed of three indicators measured in mode B or formative. Specifically, this construct was formed by the representative indicators of the gases emissions into the atmosphere (E1), the resources used in the development of the company's activities (E2) and the environmental innovations undertaken to protect the environment (E3) (Refinitiv, 2021).

The Social pillar includes four indicators measured in mode B or formative. The first indicator referred to the workforce score (S1), the second dealt with human rights (S2), the third focused on the community where the company is located (S3) and a fourth indicator referred to product responsibility (S4) (Refinitiv, 2021).

The third pillar of sustainability was the Governance factor, also with a formative scale measure or in mode B and composed of three indicators. The management category measured as the commitment towards following best practice corporate governance principles (G1) was configured as the first of these, followed by the indicators related to the relationship with shareholders (G2) and the company's CSR strategy (G3) (Refinitiv, 2021).

ESGC, is a single-element construct that measures a company's exposure to ESGC, and negative events reflected in the global media (Refinitiv, 2021). Thomson Reuters' methodology uses a percentile scoring formula that compares each company to its industrial group based on 23 ESGC topics. This procedure yields an ESGC score, reflecting how strongly a company has been committed to ESGC compared to its industrial group (Fauser & Utz, 2021). The ESGC score has a minimum value of 0 and a maximum of 100 (Aouadi & Marsat, 2018).

The endogenous CFP construct has been designed as a market valuation measure of each company, since it incorporates the indicators of the price, the Tobin's Q ratio, and the Market Value of Company (hereinafter, MVC). A formative or B mode measurement scale was also used. We advance this construct one year with respect to

ESGC to capture the time effect and note the influence that bad news can have on CFP. Regarding the indicators that shape the construct, Tobin's Q is the ratio between the market value and the total assets of a company. The price indicator is the last available closing price of company shares and the MVC is the consolidated market value of a company shown in local currency. The three variables are defined by the Eikon database (Refinitiv, 2021).

The score E, S, and G of the ten indicators highlighted above range from 0 (lowest) to 100 (highest). The validity of the scales of the three pillars is given by the data provider (Refinitiv, 2021) as well as by their use in previous works (Utz, 2019; Dorfleitner et al., 2020; Svanberg et al., 2022).

Table 1. Statistical summary

Indicators	*Mean*	*Minimum*	*Maximum*	*Std. deviation*
$ESGcont_{2018}$	90.64	1.14	100	23.02
P_{2019}	15.66	0.01	727	50.51
$logMVC_{2019}$	9.13	5.51	12.27	0.98
$TobinsQ_{2019}$	0.64	0.03	9.86	1.02
$E1_{2019}$	52.14	0.23	99.77	28.75
$E2_{2019}$	52.61	0.41	99.8	29.00
$E3_{2019}$	49.39	30.12	81.06	24.47
$S1_{2019}$	51.92	0.19	99.81	28.87
$S2_{2019}$	50.70	2.17	95.83	28.31
$S3_{2019}$	51.34	0.74	99.81	29.04
$S4_{2019}$	51.58	27.52	99.78	26.02
$G1_{2019}$	54.98	0.05	99.89	30.29
$G2_{2019}$	53.59	0.18	99.78	27.93
$G3_{2019}$	57.10	1.69	99.6	29.74

Source: Data from the Eikon dataset by Thomson Reuters in SmartPLS v. 3.3.

The summary statistics (Table 1) show that the highest values of indicators E, S, and G corresponded to G1: Corporate governance management (99.89) which contains data on the remuneration policy, the board of directors and its independence, the independence of the audit committee or the separation of the CEO and the chairman. Ranking second was S1 or the workforce score (99.81) which relates to training and development policy, safety and health policy, equal opportunities, flexible hours, wage gaps and employee turnover, among others.

The ESGC (ESGcont2018) rating starts from an average value of 90.64, thus highlighting that this dimension weighs heavily on the ESG components of O&G companies as a controversial industry (Aouadi & Marsat, 2018) compared to the remaining attributes of pillars E, S, and G. E2 or the emissions score, also represents a high maximum value of 99.8 in the 264 companies with data for this index, in which factors such as total CO_2 emissions, emission policies and objectives, climate change opportunities, environmental restoration, waste management, environmental expenses and revenues and reduction of the impact of labor transport are all taken into consideration.

SmartPLS 3.3.3 software (Ringle et al., 2015) was used to design the nomograms and apply the structural equation algorithms.

3.2 Composite – based SEM analysis

The relationship model between E, S, and G pillars with CFP were estimated as composite since we have considered these as being forged concepts. The representative indices of the three sustainability pillars are human conventions that do not exist as phenomena of nature, nor are they behavioral constructs (Henseler et al., 2013; Henseler, 2017). In addition, they are weighted linear combinations of other indicators. Hence, we took the decision to operationalize our concepts as emerging variables incorporated into a composite model. This composite model approach has the potential advantage that each construct is fully integrated by observable variables or indicators. Consequently, the statistical method used, composites based on Structural Equation Modeling helps in the interpretation and estimation of path coefficients (Yu et al., 2021) since CSR is a forged concept or human convention. Being a subtype of SEM, it follows the same steps as SEM, that is, first we evaluate the measurement model to verify its reliability and validity and second, we evaluate the structural model in order to test the hypotheses and other quality criteria of our models (Chin, 2010; Richter et al., 2016; Hair et al., 2019).

The introduction of the moderating variable in our model is justified to indicate that the relationship between E, S, and G scores and CFP may not be constant due to the ESGC effect. The incidence of negative CSR events in the media can change the intensity and direction of the relationship between E, S, and G and CFP.

Within the area of interaction effects, there are three approaches to the creation of the moderator term (Henseler & Chin, 2010; Rigdon et al., 2010): (a) the product indicator approach, (b) the orthogonalization approach and (c) the two-stage approach. Henseler & Fassott (2010) recommend that when the tested model contains formative exogenous variables, the two-stage approach be applied instead of the product indication. Consequently, during the first stage the model was estimated without the term moderator, obtaining the scores of the constructs. In the second stage, these scores were used to multiply them by the moderate variable. A single-item measure was thus obtained and used for the term interaction (Chin et al., 2003).

In short, the analysis used in this study was the composites-based SEM described by Yu et al. (2021) justified by the use of forged variables. We used two models to test the hypotheses. The first model estimated the relationships between the E, S, and G scores, as well as ESGC with respect to CFP, as shown in the equation of model 1.

$$CFP_{i,2019} = \beta_0 + \beta_1 E_{i,2019} + \beta_2 S_{i,2019} + \beta_3 G_{i,2019} + \beta_4 ESGCont_{i,2018} + \varepsilon_i \qquad (1)$$

The second model introduced the moderating effect of ESGC on the relationship between E, S, and G scores and CFP. We incorporated the interaction variables (Environmental*ESGCont), (Social*ESGCont) and (Governance*ESGCont) in model 2.

$$CFP_{i,2019} = \beta_0 + \beta_1 E_{i,2019} + \beta_2 S_{i,2019} + \beta_3 G_{i,2019} + \beta_4 (E_{i,2019} * ESGCont_{i,2018}) + \varepsilon_i \qquad (2.1)$$

$$CFP_{i,2019} = \beta_0 + \beta_1 E_{i,2019} + \beta_2 S_{i,2019} + \beta_3 G_{i,2019} + \beta_4 \left(S_{i,2019} * ESGCont_{i,2018}\right) + \varepsilon_i \qquad (2.2)$$

$$CFP_{i,2019} = \beta_0 + \beta_1 E_{i,2019} + \beta_2 S_{i,2019} + \beta_3 G_{i,2019} + \beta_4 \left(G_{i,2019} * ESGCont_{i,2018}\right) + \varepsilon_i \qquad (2.3)$$

The use of both models is consistent with the approach applied in Becker et al. (2018). The first model (Figure 1) is proposed to provide empirical evidence on the positive relationship between E, S, and G scores and CFP (H_1^+, H_2^+, H_3^+) and the negative relationship between ESGC and CFP (H_4^-).

In this vein, we study the explanatory power of ESGC to predict CFP, assuming a significant negative path coefficient to provide support on the relevance of this variable (model 1). In addition, because of the inconclusive results obtained from the previous literature on the hypothetical direction between E, S, and G and CFP, we have incorporated an effect that moderates this relationship through the ESGC construct (model 2).

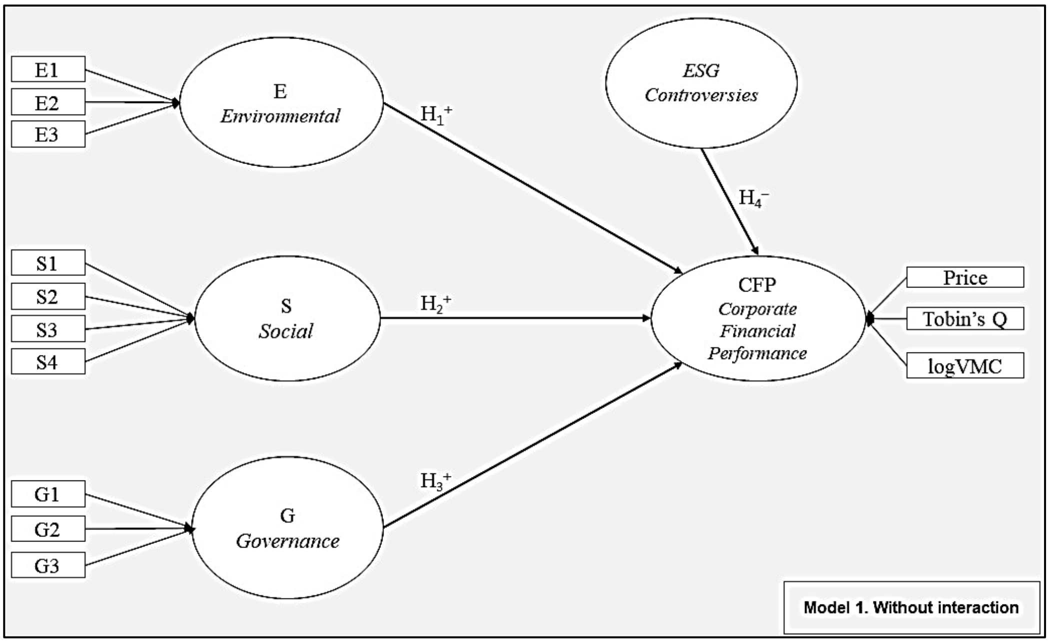


Figure 1. Relationship between constructs without interaction – moderation effect through SmartPLS v. 3.3. Model 1

Model 2 highlights the ESGC role as a moderating variable that impact on the positive effect of ESG activities (Figure 2). By controlling the reliability and validity of the two models during the analysis period, the aim was to determine whether there were differences between CFP and moderated CFP.

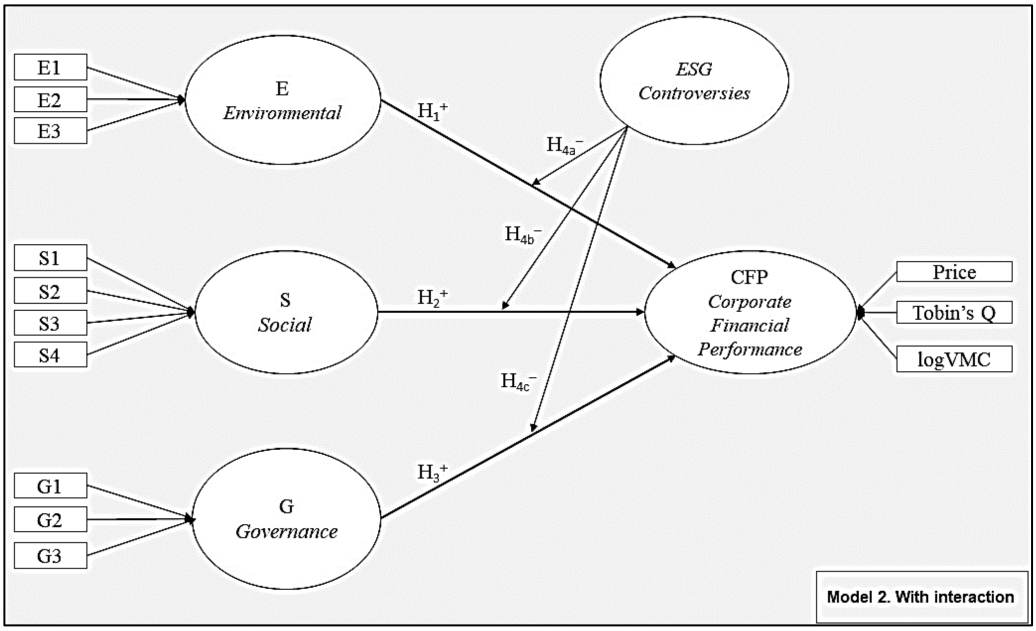


Figure 2 Relationship between constructs with interaction – moderation effect through

SmartPLS v. 3.3. Model 2

4. Results

4.1 Evaluation of model 1 results

The first set of results obtained after processing model 1 proved the validity of the construct scale, that is, the evaluation of the measurement model. As the measurement model was designed in mode B or formative, it was verified through the collinearity statistics of the variance inflation factor. The multicollinearity of the training indicators was not a problem since they did not exceed the reference value of 3.3. In addition, the relevance and significance of the weights were studied. A bootstrapping process was carried out with 10000 subsamples, bootstrap percentile, at a significance level of 5%, along with the test of 95% confidence intervals (Table 2).

Table 2. Weights, statistic t, p-values, and confidence intervals of the formative model indicators

Measurement ratios	*Weight*	*Statistic t*	*p-value*	*CI 5%*	*CI 95%*
E1 – Environmental	0.401	3.881	0.000***	0.217	0.555
E2 – Environmental	0.703	7.799	0.000***	0.551	0.845
E3 – Environmental	-0.004	0.045	0.482^{ns}	-0.153	0.150
S1 – Social	0.555	4.938	0.000***	0.364	0.733
S2 – Social	0.069	0.794	0.214^{ns}	-0.072	0.215
S3 – Social	0.176	1.659	0.049*	-0.002	0.348
S4 – Social	0.463	5.213	0.000***	0.307	0.597
G1 – Governance	0.409	3.273	0.001**	0.172	0.584
G2 – Governance	-0.108	0.796	0.213^{ns}	-0.323	0.123
G3 – Governance	0.813	9.841	0.000***	0.663	0.934
P – CFP	0.048	0.420	0.337^{ns}	-0.133	0.240
Tobin's Q – CFP	-0.179	1.518	0.064^{ns}	-0.411	-0.032
logMVC – CFP	1.001	37.776	0.000***	0.959	1.048

Source: bootstrapping procedure through SmartPLS v. 3.3. ^{ns} not significant. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Statistical significance t and 95% percentile confidence interval (CI) performed using a 10,000-repetition bootstrapping procedure.

Table 2 shows that, for the environmental construct, the most relevant indicator of the sample of O&G companies was gas emissions (A2=0.703) followed by resource use (A1=0.401). Furthermore, both weights were significant with p-values under 0.05, unlike the environmental innovation indicator (A3) which did not reach relevance (weight=0.004) or significance (p-value=0.482) in the formation of the environmental construct. For the social construct, the most important indicator of the sample was the workforce (S1=0.555) followed by product responsibility (S4=0.463), both significant (p-value=0.000), and the social community (S3=0.176) which was also significant (p=0.049). However, the score relative to Human Rights (S2=0.069) was not significant (p-value=0.214) and was irrelevant because it was close to zero. For the governance construct, the indicator with greater weight of our O&G companies' sample was CSR strategy (G3=0.813) followed by the board management (G1=0.409), with an adequate level of significance in both cases. The G2 indicator relating to the shareholders relationship (p-value=0.213) was not significant. Regarding the financial performance construct, only the market value of the company was significant at a 5% level.

The second set of results obtained after processing model 1 show the structural model evaluation, that is, the relationships between the proposed constructs or hypotheses, also assessing a series of quality statistics of the model such as, for example, the coefficient of determination.

In this phase of evaluation of the structural model, it was verified in the first instance that there was no multicollinearity between constructs as the variance inflation factor returned values lower than 3.3.

The coefficient of determination R^2 for financial performance was 0.388, indicating that a moderate amount of variance was explained by the predictive constructs in the model, according to Chin (1998). In addition, to evaluate the R^2 values of all the endogenous constructs, the size of the effect (f^2) was calculated. Specifically, the f^2 value of the positive effect of ESGC was 0.042, the positive environmental effect was 0.026, and the social effect was 0.057. In addition, the effect size of positive governance was 0.004. All f^2 size effects, except governance, were higher than the minimum cut-off value of 0.02 (Cohen, 1988). Finally, to evaluate the predictive capacity of the model outside the sample as a criterion of predictive accuracy, the Value of Q^2 of Stone-Geisser was calculated (Geisser, 1974; Stone, 1974). Through the blindfolding procedure, a Q^2 or predictive relevance of the model was obtained, which revealed that all endogenous variables had values above the threshold of 0.

The results shown in Table 3.A) reveal that the social and environmental pillars had a positive and significant effect on financial performance (path=0.309 and 0.224, respectively; p-value=0.001 and 0.010, respectively), and ESGC had a negative and significant effect on the performance (path= –0.170; p-value=0.000). While the governance rating was neither relevant nor significant (path=0.063; p-value=0.156).

According to the estimates of model 1, this study supports Hypotheses 1 and 2 (H_1, H_2), which reveal a significant and positive effect of the environmental and social scores on CFP but finds a negligible effect of governance on CFP (H_3). In addition, the results support Hypothesis 4 (H_4) which indicates a significant adverse effect of ESGC on CFP. Thus, model 1 seems to suggest that ESG practices benefit CFP, while bad news from the media or CSR practices harm CFP.

Table 3. Results of the structural model tests

Structural relationships	***Path***	***t***	***p-value***	***CI95%***	***Conclusion***
A) Model 1					
ESGC - CFP	– 0.170	3.718	0.000***	[-0.238, -0.089]	H_4 supported
Environmental - CFP	0.224	2.330	0.010*	[0.057, 0.372]	H_1 supported
Social - CFP	0.309	3.259	0.001**	[0.168, 0.481]	H_2 supported
Governance - CFP	0.063	1.010	0.156^{ns}	[-0.030, 0.177]	H_3 not supported
B) Model 2					
Moderation effect					
Environmental*Controv. - CFP	– 0.102	2.160	0.015*	[-0.187, -0.034]	H_{4a} supported
Social*Controv. - CFP	– 0.109	2.325	0.010*	[-0.194, -0.042]	H_{4b} supported
Governance*Controv. - CFP	– 0.068	1.429	0.076^{ns}	[-0.158, -0.003]	H_{4c} not supported

Source: bootstrapping procedure through SmartPLS v. 3.3. ^{ns} not significant. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$. Statistical significance t and 95% percentile confidence interval (CI) performed using a 10,000-repetition bootstrapping procedure.

A good fit is required before interpreting moderation analysis in a structural model in the context of PLS-SEM (Henseler et al., 2016). Consequently, we studied several goodness of fit indices for model 1. These include an approximate adjustment measure or Standardized Root Mean Square Residual (SRMR) (Hu & Bentler 1998, 1999) and exact adjustment tests based on bootstrapping (Dijkstra & Henseler, 2015). The absolute measure of SRMR adjustment was 0.044 less than the recommended value 0.08.

Similarly, the bootstrap results showed a good fit for model 1 (see Table 4); both bootstrap based SRMR, as well as the unweighted least squares discrepancy (d_{ULS}) and the geodesic discrepancy (d_G) were lower than the value of the 95% confidence interval (Henseler et al., 2016). Thus, this goodness of fit analysis seems to support the composite model, and the research appears to act as a confirmatory type (Henseler, 2017).

Table 4. Model 1 goodness of fit analysis

	Original value	***CI95%***
SRMR Measurement	0.044	0.051
Euclidean distance d_{ULS}	0.205	0.276
Geodesic distance d_G	0.066	0.082

Source: 10,000-repeat bootstrap process in SmartPLS v. 3.3.

4.2 Evaluation of model 2 results with moderation effect

From a theoretical perspective, ESGC are expected to moderate the effects of positive CSR activities on CFP (Fauser & Utz, 2021). Thus, for example, companies are unlikely to intend to apply CSR practices simply because they believe they can do so. However, ESGC can determine how and to what extent CSR influences the variability of CFP.

Moderation analysis showed that the term environmental interaction by ESGC had a significant effect on CFP, also the social term of ESGC had a significant effect on CFP. However, moderation was not found to be significant for the governance term (see Table 3.B).

The results of model 2 supported Hypotheses 4a and 4b (H_{4a}, H_{4b}) and found that there is a significant moderating effect of ESGC on the relationship between the Environmental and Social pillars with CFP but did not find a significant moderating effect of ESGC in the case between the governance and CFP score (H_{4c}).

This study examines ESGC at three levels to determine whether the relationships between E, S, and G and CFP vary with different levels of ESGC. The analysis of the conditional moderating effects of Table 5 shows the effects of E, S and G at three levels of ESGC: one standard deviation (SD) minus one, which equates to low levels of ESGC; the mean, which is equivalent to the average levels of ESGC in the sample; and one standard deviation plus one, which equates to high levels of ESGC.

Table 5. Conditional analysis of moderation

Exogenous variable	***ESGC Moderator***	***Path***	***P values***	f^2
Environmental	– 1 SD	0.34*	0.015	0.016
	Mean	0.23**	0.008	0.029
	+ 1 SD	0.13*	0.015	0.016
Social	– 1 SD	0.43*	0.010	0.016
	Mean	0.32***	0.000	0.063
	+ 1 SD	0.21*	0.010	0.016
Governance	– 1 SD	0.14^{ns}	0.076	0.007
	Mean	0.07^{ns}	0.141	0.005
	+ 1 SD	0.00^{ns}	0.076	0.007

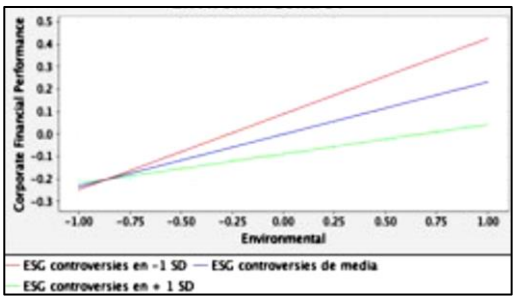
Source: Procedure through SmartPLS v. 3.3. The moderator values are the mean and plus/minus one standard deviation of the mean. ^{ns} not significant. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

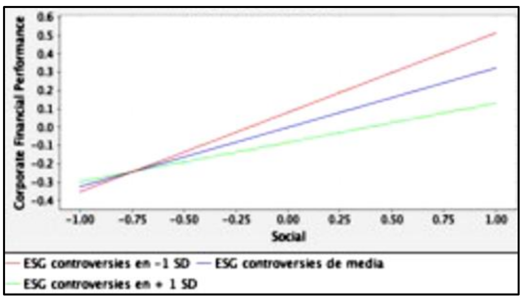
The strength of the association between E, S and G and CFP decreased as the values of the ESGC increased.

The conditional analysis revealed the extent of the moderation effect. As can be seen in Table 3, the environmental term interaction by ESGC has a negative effect on CFP (– 0.102). While the results of Table 5 suggest that the relationship between the environmental pillar and CFP is 0.23 for an average level of ESGC, for higher values of ESGC (e.g., if ESGC is increased at one point in the standard deviation), the relationship between environmental score and CFP is reduced based on the dimension of the interaction term (i.e., 0.13). Conversely, for low levels of ESGC (e.g., if ESGC is reduced at one point in its standard deviation), the ratio between the Environmental pillar and CFP becomes 0.34. Therefore, higher levels of the Environmental pillar are closely related to higher levels of CFP, but due to the negative term interaction, higher levels of ESGC lead to a weaker relationship between environmental score and CFP. While lower levels of ESGC imply a stronger relationship between the Environmental pillar and CFP.

Similarly in Table 3, the social term interaction due to ESGC has a negative effect on CFP (–0.109). The results of Table 5 suggest an average relationship between the Social pillar and CFP of 0.32. For higher values of ESGC, the ratio is reduced to 0.21. Conversely, for low levels of ESGC, the ratio increases to 0.43. Consequently, variability occurs in the relationship between the Social pillar and CFP when ESGC levels are higher or lower respectively. Therefore, applying the same procedures, the findings in Table 5 are consistent with H_{4b}, suggesting that the positive effect of the Social pillar on CFP is moderated by ESGC. The effect is strongest when ESGC are favorable and weaker when ESGC are unfavorable. In the case of the Governance pillar, the moderation hypothesis was not supported in the sample of O&G companies used.

Figures 3a and 3b illustrate the slopes of CFP variability based on ESGC levels.





(a) ESGC-Environmental (b) ESGC-Social

Figure 3. Moderation relationship ESG Environmental Social – controversies through SmartPLS v. 3.3

The coefficient of determination R^2 for moderate CFP grew to 0.398, indicating that model 2 including the moderating effect of ESGC explained the relationships tested better than model 1. In addition, model 2 using conditional sensitivity analysis provided more detailed information.

5. Discussion and conclusions

The main goal of this paper is to determine to what extent controversies influence O&G industry performance. To this end, a sample of 264 international companies were analyzed, for which the relationship of Environmental, Social and Governance factors in CFP had previously been analyzed. Based on previous research we predicted that ESGC moderate the relationships between the ESG factors and CFP. The results have found that ESGC negatively influence the relationship between the Environmental factor and CFP, as well as between the Social factor and the CFP of the companies' sample. Furthermore, this study also finds that there is a significantly positive relationship between Environmental and Social factors and CFP but not for Governance factors.

Regarding the relationship between ESG and CFP, our results clearly reveal that Environmental and Social factors have a positive and significant influence on CFP, which supports our Hypotheses H_1 and H_2. Namely, the results suggest that the Environmental factor, mainly influenced by emissions and the use of natural resources, positively impacts the CFP of O&G companies. That is, an improvement in this factor, enables better results at the financial level. These results are in line with authors such as Bunse et al. (2011) and Fan et al. (2017) who have demonstrated that the improvement in energy efficiency in the production processes of companies led to an improvement in the financial performance indicators. Other authors, such as Tamayo-Torres et al. (2019) and Wang & Sarkis (2013) for a sample of US and European companies, did not find a positive relationship between environmental indicators and financial performance. The disagreement suggests that the O&G industry might be giving more importance to these kinds of factors given the high impact of its activity on the market and on environment. Indeed, given than this industry is one of the highest contributors to CO_2 emissions globally (International Energy Agency, 2021), it is to be expected that the stakeholders of these companies take this issue into account. Investors will reward an environmentally responsible company over those that are not (Bodhanwala & Bodhanwala, 2020).

In the same sense, it has been confirmed that the Social factor, through the workforce and product responsibility mainly, positively influences financial performance in the O&G industry lending support to our second hypothesis. It has been shown that HR policies greatly influence the perception of workers or job retention. Authors such as de Roeck & Delobbe (2012) and Raman (2018) have shown for the mining industry and the petrochemical industry, respectively, that the management of these social policies has an impact on job retention and the perception of the company. Moreover, previous literature showed that companies with a socially responsible profile can benefit financially in various ways. This may be access to cheaper financing sources (Small & Zivin, 2005) or a preference by private investors for Socially Responsible Investments (SRI) (Chatzitheodorou et al., 2019). However, for Erhemjamts et al. (2013) and Tamayo-Torres et al. (2019) there is no direct positive relationship between the two factors. Nonetheless, our results suggest a direct relationship between the Social factor and CFP in the O&G industry. The results confirm that a higher level of Social factor enables companies to enjoy an improvement in financial performance. Since the O&G industry is a controversial industry, companies are frequently in the spotlight. Investors and society consider issues such as respect for Human Rights regarding the workforce (Pegg, 2012), or how responsible they are in terms of the product. The latter is one of the factors that most explain the Social pillar within our analysis. Aspects of the O&G industry can be highly detrimental, not only for the environment, but also for society in general, the generation of geopolitical conflicts being just one example.

When the relationship between the Governance factor and the CFP of the O&G industry is analyzed, the results obtained are inconclusive, since the relationship between the Governance factor and CFP is not significant for the study sample and thus, our third hypothesis is not supported. In contrast to this result, authors such as Arayssi et al. (2016) have shown that the presence of a greater number of women on the board, taken as a measure of responsible governance, contributes to an improvement in financial performance. Tamayo-Torres et al. (2019) have shown that the Governance factor has a positive relationship with financial performance. The result obtained in our sample forces us to reject Hypothesis H_3. As we have said before, the O&G industry is criticized for the damage caused at an environmental level, and to a lesser extent at the social level. Both investors and society in general tend to give greater importance to these factors, leaving the governance factor in the background. This may explain why the governance factor does not significantly influence the financial performance of companies in the O&G industry. By contrast, authors such as Shakil (2021) have shown, for an international sample of 70 O&G companies, that a greater number of women in corporate governance reduces systematic risk.

Moving on, and in line with our main goal, we analyze the influence of ESGC on the relationship between the ESG factors and CFP in the O&G industry. In this vein, results support that ESGC negatively influence the relationship between the Environmental and Social factor regarding CFP which supports our fourth (H_{4a} and H_{4b}) hypotheses. When there is less harmful news, social and environmental practices contribute to improving CFP. Specifically, the lower the value of ESGC is, the stronger the relationship between Environmental factor and CFP is. We note the same regarding the social factor. Those companies that are less affected by this kind of news will see how their responsible policies have a greater positive impact on financial performance, compared to those that are affected by bad news (Aouadi & Marsat, 2018; DasGupta, 2021). Shakil (2021) demonstrates that ESGC have a moderating effect on the relationship between ESG factors and financial risk. The results are in line with authors such as Nirino et al. (2021) and Tamayo-Torres et al. (2019). However, there is no moderating effect between the governance factor and CFP and our fourth hypothesis (H_{4c}) is not met. The results suggest that the study sample is more exposed to adverse news when this refers to environmental and social issues. Indeed, the industry under study is sometimes criticized for its unethical practices regarding oil extraction, such as "fracking" (Brantley et al., 2014).

The previous considerations permit us to conclude that higher levels of ESGC are detrimental to the positive influence of ESG practices on the CFP of O&G companies. In this sense, the article contributes new knowledge to the field, particularly in the flourishing literature on ESG and, more specifically, in the area of controversies. In this way the article contributes to reinforcing the United Nations (2015) statement calling for responsible practices within companies, in this case in the influential O&G industry, with the objective of improving the environment and society. It has been demonstrated that controversies have an important effect on performance and therefore deter companies from entering into certain questionable social practices and encourage adoption of measures to reduce their impact. In this regard, government regulation that raises awareness in society would appear to be constructive because this awareness would foster a greater change in business actions as controversies become more prevalent and more impactful. Industries such as energy, namely O&G, must be the focal point of promoting environmentally responsible policies that contribute to the reduction of emissions and an improvement in efficiency in the use of natural resources. We have seen how investors and society have become increasingly involved in making companies accountable in these aspects, contributing to their corporate governance and dictating social and environmental policies that mitigate the negative impact of certain practices. This transition towards less polluting energies should emerge from greater awareness, commitment and support from policymakers and government agencies, so that industries can carry out, in an economically viable way, the changes that enable an improvement in the health of our planet.

On the other side of the coin, the managers of O&G's companies must be made aware about the impact that ESGC have on performance, so that they place greater attention to Environmental, Social and Governance factors in order not to damage the value of the company and harm stakeholders.

This study has certain limitations that suggest new lines of research. First, the results have been provided in an international context, but the degree of regulation differs between countries and thus controversies should be considered differently manner in different areas which suggests the convenience of new research that discriminates between countries. Second, controversies exert their impact in a later period, but we do not know the duration of their impact. Thus, introducing a longer period for measuring impacts could be of interest to appreciate the different intensity of news and to give guidance to government and companies.

During Chapters 2 and 3 it possible to observe the statistical relationship between ESG factors and corporate financial performance. However, this relationship may or may not apply to the performance that financial markets have on sustainable investment, through what is known as Socially Responsible Investment. In view of knowing if investors really bet more on sustainable investment over conventional investment, we consider it appropriate to analyze this issue in Chapter 4 of the thesis. Through the risk –

return ratio, and the study of conventional stock indices and sustainable stock indices, the investor attractiveness of both types of investment will be compare. In this way, we will be able to know if the financial markets are prone to the energy transition or not.

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CHAPTER IV. THE ENERGY TRANSITION IN THE FINANCIAL MARKETS. COMPARATIVE RISK-RETURN STUDY FOR TRADITIONAL, SUSTAINABLE AND RENEWABLE ENERGY STOCK MARKET INDICES.

IS IT ATTRACTIVE TO INVEST IN ALTERNATIVE ENERGY? EVIDENCE FROM A FIVE-FACTOR FAMA-FRENCH MODEL FOR REGIONAL DJSI AND RENEWABLE STOCK INDEXES

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IS IT ATTRACTIVE TO INVEST IN ALTERNATIVE ENERGY? EVIDENCE FROM A FIVE-FACTOR FAMA-FRENCH MODEL FOR REGIONAL DJSI AND RENEWABLE STOCK INDEXES

Abstract

Purpose – This study aims to examine the attractiveness of the regional Dow Jones Sustainability Indexes (DJSI) and several renewable energy indexes during December 31, 2010, to December 31, 2019. This study uses a risk – return analysis and a set of explanatory factors. Lastly, this study conducts a comparative analysis of these indexes with conventional indexes.

Design/methodology/approach – This study uses data from Eikon, a Thomson Reuters database. To analyze the indexes' behavior, this study uses the indexes' annual return as of December 31 for each year. Next, this study estimates the Fama and French's five-factor model using an ordinary least squares regression for regional DJSI and renewable energy indexes.

Findings – The results show that regional DJSIs delivered returns both above and below conventional indexes. In contrast, renewable energy indexes had high betas and negative returns, making them unattractive to investors.

Practical and social implications – The results imply the need for public financing programs that support the transition to a sustainable economy and reduce risk and increase the return on private investment. This study provides insights for policymakers regarding the importance of sustainability indexes in the transition to a green economy.

Originality/value – This study contributes to the growing literature on Fama and French's five-factor model of sustainability indexes, especially in the current context characterized by intense green political changes. This study complements the few studies that have addressed the economic implications of renewable energy indexes in markets.

Keywords: Renewable energy, Socially Responsible Investment, DJSI, Stock indexes, Risk–return analysis.

1. Introduction

Socially Responsible Investment (SRI) consist of incorporating a company's good practices regarding environmental, social, and governance into the asset selection process (Miralles-Quiros et al., 2020). SRI and renewable energy have become increasingly relevant in recent decades (Ivanisevic, 2019; McCollum et al., 2018). An increasing number of individual investors, institutional investors and portfolio managers are incorporating SRI into their portfolios. The importance of investing in SRI is apparent as it accounted for US $30683tn in investments in the top five markets (Europe, USA, Japan, Canada, and Australia | New Zealand) at the beginning of 2018. All markets experienced growth, with Japan leading the way with a 300% increase since 2016; meanwhile, in Europe, sustainable investing assets have declined relative to total managed assets since 2014 (Global Sustainable Investment Alliance, 2018).

Public policies that promote a transition to a more sustainable and environmentally friendly economy may also be relevant (Jacobsson & Lauber, 2006; Martens & Rotmans, 2005; Wiser & Pickle, 2017). It is sometimes assumed that SRI, particularly environmentally sustainable investments, must be supported by public policies to be financially attractive (Egli, 2020; Polzin et al., 2015; Yi & Feiock, 2014). The United Nations Principles for Responsible Investing (PRI) (United Nations, 2006) asks investors to align themselves with society's broader objectives through their investment decisions. An increasing number of forums adopt PRI principles in this vein, such as the Forum for Sustainable and Responsible Investment in the USA or the European Sustainable Investment Forum in Europe. In addition, the 2030 agenda requires investors to redirect their investment flows toward sustainable development investments, thereby contributing to the achievement of sustainable development goals (SDG). This concern suggests interest in studying the relationship between a company's financial and sustainability performance.

This study analyzes sustainability investments in economic, social, and environmental terms. This study focuses on environmental factors through the analysis of renewable indexes. The study of renewable companies is of great importance in achieving public policies that incentivize this industry in regions where private investment is weaker (Aslani, 2014). However, this kind of research is underdeveloped. Most studies focus on the causal link between the price of oil, changes in technology and renewable companies (Henriques & Sadorsky, 2008; Inchauspe et al., 2015; Kumar et al., 2012; Sadorsky, 2012b). Furthermore, the relevant literature is incomplete in terms of companies' financial and environmental performance and suffers from mixed results because of the samples used, the period chosen, or the econometric models applied (Cedrick & Long, 2017; Mazzucato & Semieniuk, 2018). For example, Reboredo et al. (2017) found a lower return on renewable energy funds on SRI investments, whereas Rezec & Scholtens (2017) found otherwise. Therefore, some research questions remain unanswered, and there is still a field open to study.

Private investors need to know whether their positions in the market's moneymaking with respect to the risk will be they bear (Dilla et al., 2016). Public subsidies will eventually become extinct to make way for private capital (Justice, 2009). In this sense, our research seeks to address this research gap by answering the following questions: can investors in sustainable indexes and renewable energy expect a return according to their risk level? Is it more cost-effective to invest in sustainability and renewable energy than conventional indexes? This study's main objective is to respond to these two questions by adopting a financial risk investor stance.

We work with a broad global sample consisting of the leading sustainable and renewable international market indexes during 2010 – 2019. Most studies are based on investment funds. Funds are assets that may be affected by other issues such as fund size, age, or assets on which they fluctuate. Authors such as Schröder (2007) and Statman (2006) try to avoid this problem using Socially Responsible Investment (SRI) indexes. Thus, the sample we work with consists of stock indexes to prevent the influence of these factors on profitability. We use the multifactorial model proposed by Fama & French (2015). In addition, complementarily, we carry out a comparative study between sustainable and renewable energy indexes and conventional benchmarks. Our main results indicate that renewable energy investment is unattractive, with corresponding low returns and high betas (systematic risk).

Other studies focus on certain investment funds or types of energy (Cedrick & Long, 2017; Mazzucato & Semieniuk, 2018). However, here, we try to encompass many companies at an international level through the stock indexes. Thanks to a broad and global sample of stock indexes, this study contributes to broadening the knowledge in this research field. It allows us to know and compare the risk – return ratio of these assets to make investors' decisions. Meanwhile, as we study stock indexes instead of specific companies, these indexes provide us with a more general vision as these are, in turn, made up of many companies.

As one of our objectives to know each index's profitability and its investment risk, our model can be of great help to the investor community. Therefore, investor attractiveness is understood as an investment in an asset that provides high returns and low risk. This relationship is the risk – return duality on which this study's analysis is based (McInerney & Bunn, 2019; Wüstenhagen & Teppo, 2006). This duality consists of comparing the index's performance concerning the beta factor of the investment (risk), a concept that we will analyze later.

The results suggest that this investment requires government institutions' support to ensure that the investor has enough confidence to be a part of long – term sustainable companies (Andersen et al., 2019). Once the private industry is more focused on such investments, financial support from the public industry will decline rapidly.

The remainder of the paper is organized as follows. Section 2 provides a detailed literature review of the financial and environmental performance of sustainable companies; Section 3 describes the data and methodology used; Section 4 presents the results; Section 5 undertakes the discussion; and Section 6 presents the conclusions and political implications.

2. Literature review

2.1 Sustainability as a responsibility investment

Recently, there has been an increase in SRI worldwide (Global Sustainable Investment Alliance, 2018) in accordance with investors' growing commitment to align their investments with broader societal objectives, as defined in the SDG (United Nations, 2006). SRI strategies are of interest to practitioners and academics in finance, particularly with respect to performance measurement.

The relationship between a company's sustainable activity and its financial performance has attracted attention in recent years (Aboud & Diab, 2019; Ambec & Lanoie, 2008; Badía et al., 2020; Becchetti & Ciciretti, 2009; Cunha et al., 2020; Iwata & Okada, 2011). Studies have used various approaches to explain how and why the sustainability variable affects financial performance and have found different results (Chan & Walter, 2014). For example, while Inchauspe et al. (2015) find poor financial performance for companies listed in the Wilderhill New Energy Global Innovation Index, others such as Fang et al. (2020) find that there is a premium green factor.

The return on investing in companies is manifested through the cash flows they are generating for their investors. A company with high cash flow improves its financial performance, and with it, the stock price is higher (Campbell & Shiller, 1988). In general, value – creating companies reflect a high return that is higher than the cost of capital.

On the one hand, studies on sustainable companies show that this overperformance does not occur (Geczy et al., 2005). In their portfolio theory, Stuart & Markowitz (1959) mention the penalty of restricting investment in sustainable companies. Renewable energy companies are highly volatile and perform less well than expected owing to the nature of the industry they are in (Angelopoulos et al., 2016; Gross et al., 2010; Wüstenhagen & Teppo, 2006). Sadorsky (2012a) demonstrates that for a set of renewable companies listed in the North American market, the systematic market risk is higher than one (beta > 1) during 2001 – 2007. For a sample of 14 indexes around the world, Rezec & Scholtens (2017) find that sustainable indexes' performance was unattractive from an investment approach. Moreover, the risk of these indexes was much higher than conventional indexes.

On the other hand, some studies find excellent financial performance of sustainable and renewable companies based on various assessments. Thus, sustainable companies receive aid and public funding, which improves their financial performance (Fang et al., 2020). Continuous advancement in technology allows for cost savings and increased productivity. This explains sustainable companies' benefits (Narayan, 2018). Another factor that this approach considers is pollution. From an investor's perspective, companies with very high pollution rates may be unattractive. Rather, investment in the prevention of this problem can lead to economic benefits (Albertini, 2013). Investor attention to this kind of asset may be another contributing factor to good performance. In many cases, these types of companies are considered as very responsible at the social and environmental levels. This in turn contributes to the investor's overperformance (Ciarreta et al., 2014; El Ghoul et al., 2018).

A priori, sustainable, and renewable energy indexes are riskier as they are nascent and highly volatile companies (Dutta, 2017). Because of the instability and early emergence of the industry, investors tend to look at the risk (beta coefficient) that comes with the investment, rather than other economic-financial factors of the company (Ng & Rezaee, 2015; Xiao et al., 2013). Similar results were found by Becchetti et al. (2015), who reported a high – risk aversion to this kind of investment during the US bubble. On the one hand, investment in technology has been shown to be a crucial aspect affecting investment in sustainability. This can explain the character of constant and volatile changes in the industry (Masini & Menichetti, 2012). On the other hand, authors such as Bauer & Hann (2012) argue that sustainable companies tend to be associated with low debt costs and high credit ratings, demonstrating attractive investors and low risk in such investments. In summary, the SRI empirical research is inconclusive and reveals the need for clear standard models that help us to unify whether investment in renewables is profitable.

2.2 Fama - French's five – factors model

When analyzing the efficiency of companies' SRI, Brzeszczynski & McIntosh (2014) find that conventional factor analysis does not entirely explain profitability. Most studies have tried to relate environmental performance to profitability (Inchauspe et al., 2015; Sadorsky, 2012b; Sokolovska & Kešeljevic, 2019). Rather, we argue that the question is whether the SRI satisfies the risk – return relationship; that is, the greater the risk, the greater the return. This is embodied in the general equilibrium of the capital asset pricing model (CAPM) (Koutmos, 2015).

As CAPM returns depend only on the beta factor (systematic risk), some authors have criticized its capacity to appreciate company performance. These authors opt to use other models such as the three-factor model of Fama & French (1992), which posits that the expected return depends on the systematic risk, company size and the value effect. However, owing to its inconclusive results (Bowman, 1980; Fiegenbaum & Thomas, 1988; Henkel, 2009; Santacruz, 2019), the three-factor model has been improved with the addition of new variables. The result is Carhart's (1997) four-factor model which adds the momentum factor Winner minus Loser (WML), or Fama and French's (2015) five-factor model which incorporates the Robust minus Weak (RMW) and Conservatives minus Aggressive (CMA) factors.

Using the four-factor model, Marti-Ballester (2019) finds that there is a financial cost in renewable investments compared to conventional investments. Statman & Glushkov (2009) study the performance of renewable indexes using the four-factor model and find that the returns were not significant. Novy – Marx (2013) and Titman et al. (2004) demonstrate that the three – and four – factors models are incomplete in capturing the effects on the profitability of factors such as investment or operating returns.

According to Fama & French (2015), the five – factor model better describes average return performance than the traditional three – factor model when applied to companies with high investment and strong operating returns. The literature has shown empirical evidence of model performance. Fama & French (2017) test the three – and five – factors models for a portfolio set in 23 developed markets. They find that the model performed better in the North American and European regions and for companies with high capitalization levels. In contrast, Foye (2018) finds that the five – factors model behaved better for Eastern Europe and Latin America than the three – factor model but failed in Asia's case.

Studies that have used the five – factors model have shown that this model is suitable for analyzing the attractiveness of renewable for investors. Using the five – factors model, Martí- Ballester (2020) finds that healthcare and biotechnology companies have better financial performance than conventional funds. These industries fall under the United Nations SDG 3 (United Nations, 2019). Joliet & Titova (2018) and Sokolovska & Kešeljevic (2019) find that the factors that make up the five – factors model are considered by investors in socially responsible funds.

For these reasons, we use Fama & French's (2015) five – factors model to study the convenience of investing in SRI. Specifically, the methodology used is not based on the asset's expected returns but on the alpha that the five – factors model reports for the set of proposed indexes. This is because this model behavior is better than other asset valuation models (Miralles-Quiros et al., 2020).

As we will see in more detail in Section 3, the Fama – French five – factors model illustrates the duality relationship between profitability and the risk of an investment. Profitability is measured through the well – known Jensen alpha. This is a tool that allows us to analyze profitability adjusted to risk (Jensen, 1968). This risk is measured using the investment beta factor. If we find an asset with a high Jensen's alpha (in the eyes of the investor) and a low beta factor (below 1), we can affirm that the investment is attractive.

Following previous work on measuring investment funds (Hürlimann et al., 2019a; Lopez et al., 2007; Searcy & Elkhawas, 2012), we use returns as a representative variable of financial performance. Considering the risk – return pair as an indicator of the attractiveness of investing in sustainability, the results are mixed. Consequently, our null and alternative hypotheses are as follows:

$H1_0$: Sustainability and renewable energy indexes are attractive to the investor.

$H1_a$. Sustainability and renewable energy indexes are not attractive to the investor.

Concerning the comparison between sustainable and conventional indexes, authors such as Rezec & Scholtens (2017) show that a set of renewable and sustainable indexes has a poorer investor attractiveness than conventional indexes. Using a sample of sustainable funds for the USA, UK, Continental Europe, and the Asia Pacific, Renneboog et al. (2008) demonstrate that the return was 2.2% to 6.5% below conventional funds' returns. Other authors, such as Hamilton et al. (1993), find no statistical significance in the return of sustainable funds compared to conventional funds. Concerning the comparison between renewable and conventional investments, according to Marti-Ballester (2020), investors in renewable energy funds go beyond their financial utility when making their portfolio decisions than investors in non-renewable energy and other conventional companies.

On the contrary, some studies indicate a higher sustainable return than conventional indexes (Ortas & Moneva, 2013). The so-called green premium, the expected return on green investments compared to conventional investments (Pineda et al., 2018), is one of the newest approaches within the research. Fang et al. (2020) find a green premium for a set of sustainable companies. Their five – factors model shows that there is a higher average monthly return on sustainable than conventional companies. Chia et al. (2009) find that average profitability was above the benchmark for a group of renewable companies. Miralles-Quiros & Miralles-Quiros (2019) show that for a VAR asymmetric dynamic conditional correlation approach, alternative energy exchange traded funds (ETF) outperform conventional energy funds. Therefore, renewable energy fund investments are attractive.

Other authors argue that environmentally irresponsible companies can be perceived as risk assets (Albuquerque et al., 2019; Hong & Kacperczyk, 2009). Risk may lead to reduced financial performance (El Ghoul et al., 2018). For example, Chava (2014) finds that banks charge a higher interest rate to companies with environmental problems (high pollution rates or toxic waste). The latest study scenario calls for a more reduced financial performance in renewable indexes compared to conventional indexes. Because the results for the comparison between sustainable and conventional indexes are mixed, we establish our null hypothesis as follows:

$H2_0$: Sustainable and renewable indexes outperform conventional indexes.

The alternative hypothesis is as follows:

$H2_a$: Sustainable and renewable indexes either underperform or perform like conventional indexes.

3. Sample and methodology

3.1 Data and method

This study uses the five – factors model of Fama & French (2015) applied to a set of sustainable and renewable energy indexes. This model allows us to contrast the starting assumptions optimally because it is the most up-to-date multifactor model in asset valuation. For example, in Fama & French’s (2015) seminal article, the five – factors model provided a 71% and 94% variance in expected profitability. The three – factors model was expanded by including the profitability and investment factors owing to this model’s low efficiency to explain the variation in expected returns in portfolios with high levels of investment or profitability (Novy-Marx, 2013; Titman et al., 2004).

The indexes’ daily returns as of December 31 of each year are used to analyze index performance. Following previous studies, the daily return of both the indexes and the Fama – French factors was annualized (Nadeem et al., 2020; Searcy & Elkhawas, 2012; Sokolovska & Kešeljevic, 2019). This treatment of the sample limits the influence of outliers and improves the results obtained (Uyar et al., 2020). The study period spanned from December 31, 2010, to December 31, 2019. Data were extracted on May 4, 2020, from

Eikon, a database by Thomson Reuters (Nadeem et al., 2020; Uyar et al., 2020). Data not available in this database were queried in the databases of the respective index developers.

Following Rezec & Scholtens (2017), we conducted a brief initial study on these returns' performance using descriptive statistics such as mean, standard deviation and Sharpe ratio. The Sharpe ratio is an index widely used in the literature to compare the risk – adjusted returns of two or more investments. Return is adjusted to the asset's volatility by measuring the overperformance per unit of the asset's standard deviation (Sharpe, 1994). The Sharpe ratio was configured using the following formula:

$$SR_i = \frac{R_i - R_f}{\sigma_i}, \tag{1}$$

where R_i is the average annual return of asset i, R_f is the risk-free yearly return of the US Treasury at one month and σ_i is the standard deviation of the asset's returns i. A positive (negative) value denotes that the risk – adjusted returns are above (below) the risk – free return.

Regarding the base data used to analyze the explanatory factors, the data repository published by French (2020) was used with the same data frequency and extracted period as the return variable. This data repository is distributed by geographic regions, namely, Developed Markets, North America, Europe, and Asia – Pacific. Regarding the dependency analysis for the analyzed indexes' returns, depending on each index's constituent companies, one geographic region or another has been used. For example, the NASDAQ Renewable Edge US Liquid Index has been analyzed with the Fama – French factor sample for North America.

The underlying factor model for investment analysis was the CAPM (Lintner, 1965; Sharpe, 1964). The central argument of this model is that the market portfolio is efficient in relation to its variance (Stuart & Markowitz, 1959). Market efficiency implies that asset return is a positive linear function of the market beta, and that beta is sufficient to explain the variance in expected returns. It specifies that investors are compensated only for undiversified risk (systematic risk). CAPM had certain contradictions, the most significant being the size effect found by Banz (1981). The author shows how a company's size explains some of the variances of its return. Therefore, only considering the market's performance is insufficient. The coefficients α_i and β_i were obtained from the regression of asset return on the market's return as follows:

$$R_{it} - R_{ft} = \alpha_i + \beta_i\left(R_{mt} - R_{ft}\right) + \varepsilon_{it}, \tag{2}$$

where R_{it} is the return of the asset at time t, R_{ft} is the return of the risk – free asset at time t, R_{mt} is the return of the reference index, σ_i represents Jensen's (1968) alpha, β_i is the systematic risk of the asset and ε_{it} is the error.

Jensen's alpha, also known simply as alpha, is a measure based on risk – adjusted performance and represents the average return on a portfolio or investment. In our case, the return is for a stock market index. This performance is above or below the minimum return required by the CAPM, given a specific beta and average market return. When alpha is positive (negative), we say that the asset's return is higher (lower) relative to the market. Thus, Jensen's alpha measures the difference between the asset's return and the return reported by the reference market.

Therefore, the methodology used is based on the alpha generated by the five – factors model owing to its superior performance compared to other models (Miralles-Quiros et al., 2020). Authors such as Schröder (2007) and Sokolovska & Kešeljevic (2019) have used Jensen's alpha to assess the attractiveness of sustainable indexes.

Systematic risk (β_i) affects the difference between market returns and risk – free asset returns. This difference is what Fama & French (2015) call the market risk premium (MRP):

$$R_{mt} - R_{ft} \tag{3}$$

We try to relate Jensen's alpha and beta, or systematic risk, through the five – factors model. Jensen's alpha reflects the performance of risk – adjusted assets, whereas beta tells us the asset's volatility compared to its benchmark market. In this way, we can assess the risk – return ratio of each index. An alpha factor above zero denotes a higher positive return on the asset relative to its reference market. A beta value above one indicates that an asset is more volatile than its reference market. For example, a beta of 1.10 indicates that the asset rises ten percent more than the market when the market rises.

In short, the five-factor model is as follows:

$$R_{it} - R_{ft} = \alpha + \beta_1 MRP_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 CMA_4 + \beta_5 RMW_5 + \varepsilon_t \tag{4}$$

Here, SMB stands for Small minus Big and HML for High minus Low. Equation (4) allows us to identify the factors that influence asset returns. Here, the five – factors model's choice allows us to identify a more significant number of factors with possible influences on expected returns. Fama and French's five – factors model was estimated using the ordinary least square regression Dow Jones Sustainability Index (DJSI) regional indexes and for renewable energy indexes.

3.2 Sample

Following previous literature, we focus on the use of sustainable stock indexes and renewable energy indexes for investments globally (Hürlimann et al., 2019b; Lopez et al., 2007a, 2007b). Studying the stock index allows us to determine the performance of many companies and makes our analysis more efficient.

The study sample was divided into two blocks. To analyze investment in sustainability in global terms, the DJSI regional indexes were selected. Created by S&P Dow Jones Indices and RobecoSAM, the DJSI family of indexes comprises of leading sustainability companies, in line with Environmental, Social and Governance criteria. Companies are selected each year according to the corporate sustainability ranking developed by RobercoSAM. The DJSI index family consists of four regional indexes: the DJSI World Sustainability Composite, DJSI Europe, DJSI North America and DJSI Asia-Pacific. For detailed information, refer to Table 1.

The second block of our sample comprises renewable energy indexes. Following previous literature (Rezec & Scholtens, 2017; Sokolovska & Kešeljevic, 2019), we identified a set of stock indexes that fluctuate according to companies whose activity, directly or indirectly, is related to renewable energy. Finally, a total of 12 indexes were analyzed to extract their attractive investors. We accessed data from the suppliers of benchmark stock indexes such as the Financial Times Stock Exchange (FTSE), S&P Dow Jones Indices, NASDAQ or Wilderhill.

We also used the conventional indexes to conduct a comparative study of investor performance (Table 1). Following Rezec & Scholtens (2017), a conventional index for comparison was identified for each sustainable and renewable energy index. Two criteria were adopted to relate the indexes to their conventional indexes: that they both fluctuated according to companies in the same region and that the developers of the index were the same.

Table 1. presents a schematic of the index samples used.

Sustained/renewable energy indexes	Reference indexes
DJSI World Sustainability Composite	S&P Global 1200
DJSI Europe	S&P Europe 350
DJSI North America	S&P 500
DJSI Asia Pacific	S&P Asia Pacific BMI
Ardour Global Alternative Energy	MSCI World
Ardour Global Alternative Energy Extra Liquid	
FTSE Environmental Opportunities Renewable and Alternative Energy 50 Index	FTSE All World
Ardour Global Alternative Energy Solar	MSCI World
World Renewable Energy	
S&P Global Alternative Energy	S&P Global 1200
S&P Asia Pacific LargeMidCap Carbon Efficient Index	S&P Asia Pacific BMI
BNP Paribas Global Renewable Energies Price Return Index	MSCI World
NASDAQ Renewable Edge U.S. Liquid	NASDAQ Composite Index
S&P Global Clean Energy	S&P Global 1200
European Renewable Energy	DJ Eurostoxx
Wilderhill New Energy Global Innovation	MSCI World

Source: Own elaboration

4. Results

The results are structured in three blocks: a study of regional DJSI index and comparison
with conventional index, a study of renewable and relative energy indexes with conventional index and cost – effectiveness risk ratio for sustainable and renewable energy indexes.

As we will see, the results presented below allow the investor to know in a summarized and concise way those indices that are more optimal for investment. This statement is contrasted with the risk – return relationship that we extract from the five – factors model of Fama & French.

Following Rezec & Scholtens (2017) and Fang et al. (2020), we report a summary of the descriptive statistics generated by Fama & French's five – factors and studied indexes in Table 2.

We observe that all the factors except SMB have a direct relationship with the profitability of the indexes. With this, we can say that the factors influence the performance of said profitability.

Table 2. Descriptive statistics for factors

Factors	Mean	Median	Max	Min	Standard Deviation
Mkt-RF	8.8553	9.2950	32.4700	-16.0800	14.5196
SMB	-0.3503	-1.5800	15.8500	-10.5800	7.1745
HML	-1.3053	-3.1050	21.9000	-20.2400	9.6870
RMW	8.7208	7.0050	37.8500	-17.9700	10.3110
CMA	2.8643	2.2700	17.4200	-6.8000	5.9900
WML (Momentum)	2.8798	2.9100	21.1000	-13.7400	7.5374

Source: Own elaboration

The MRP, SMB and HML are the factors in Fama & French's (1992) three – factors model. WML is the momentum factor given by Carhart (1997). RMW and CMA are the profitability and investment factors given in Fama & French (2015), respectively.

In Table 3, we see the mean annual returns on the DJSI World Sustainability Composite and DJSI Asia Pacific indexes are higher than the conventional index. As for standard deviations (index volatility), the sustainable index is less volatile than the conventional index. The Sharpe ratio exhibits a very similar performance to that reported by the average yield. We note the value of the Sharpe ratio approaches zero but is not negative. We interpret this as a higher return on the risk – free asset.

Table 4 shows that returns are below the selected benchmark index for renewable energy indexes, with three exceptions: World Renewable Energy, S&P Asia Pacific LargeMidCap carbon Efficient Index and European renewable energy (Table 4). In terms of standard deviations, and unlike the sustainable index, volatility for renewable indexes is considerable. In all cases above the benchmark index, except for the S&P Asia Pacific LargeMidCap carbon Efficient Index. The Sharpe ratio is negative in some indexes, noting that the index in question (the benchmark index) reported less profitability than the risk – free asset (Sharpe, 1994). The Sharpe ratio of benchmarks is higher than that of the renewable index, except for the three indexes listed above.

4.1 Regional Dow Jones Sustainability Indexes and frame of reference

First, we report the results for the sustainability index obtained through the five – factors model (Table 5).

The most statistically significant variable is MRP. Thus, there is supporting evidence that the most influential factor, out of those proposed by Fama & French (2015), is the beta coefficient or systematic risk. Indexes such as the DJSI World Sustainability Composite, DJSI North America and DJSI Asia Pacific report betas lower than their benchmarks but are still close to one. In contrast, alpha coefficients are negative or close to zero and nonsignificant. Therefore, there is no positive relationship between the asset's risk and return. DJSI Europe and DJSI North America have negative returns. In contrast, the DJSI Asia – Pacific index reports a positive and significant alpha coefficient.

Concerning the size factor (SMB), only DJSI Europe has a statistically significant result at the 1% level. These values are disparate in their directions. The sustainable index has a positive direction for expected profitability, except DJSI Europe. This shows that the companies are low capitalized. In contrast, benchmarks are made up of highly capitalized companies.

Regarding the value factor (HML), investors do not consider this feature in sustainable companies, except for DJSI Europe (negative and significant at 5%). This result for DJSI Europe means that in the European sustainable indexes, the companies are growth companies with a low book-to-market ratio. If we find positive values of HML, this says that sustainable companies are "value companies", that is, companies that trade with a market value below the value of their assets.

Next, we discuss the remaining two factors the five – factors model. For the RMW, or operational profitability factor, a positive coefficient value indicates that the index is made up of profitable companies. For the DJSI World Sustainability Composite and DJSI North America, the coefficient values are positive. For the remaining two indexes, the coefficient values are negative. For reference indexes, the value is positive in all regions. Apart from the management, this factor is not considered by investors, except for DJSI Europe (significant at 10%). This result for the DJSI Europe index indicates that we faced a lack of member companies' operating returns. Another factor is the investment factor or CMA. A positive coefficient indicates that companies have high investment rates. Except for DJSI

Europe, the remaining indexes have negative values. These values indicate that companies are conservative (i.e., have low investments). The significance is null in the sample index. That is, investors do not consider this factor, except in the reference index for Europe (S&P Europe 350). Therefore, we can reject H_{10}, and accept the alternative one (H_{1a}). That is, the sustainability DJSI and renewable energy indexes are not attractive to investors.

Table 3. Descriptive statistics for regional DJSI and reference

DJSI	Reference	Average	Standard Deviation	Medium (Reference)	Standard Deviation (Reference)	Ratio Sharpe	Ratio Sharpe (Reference)
World Sustainability Composite	S&P Global 1200	11.0797	10.9574	10.6850	12.9869	0.9634	0.7825
Europe	S&P Europe 350	3.7115	15.1856	6.2430	15.7737	0.2100	0.3626
North America	S&P 500	9.8260	12.0414	1.1530	12.2611	0.7726	1.1116
Asia Pacific	S&P Asia Pacific BMI	8.5600	11.8508	7.4970	14.0408	0.6782	0.4967

Source: Own elaboration

Table 4. Descriptive statistics for renewable indexes and reference

<table>
<tr><th>Renewable indexes</th><th>Reference</th><th>Average</th><th>Standard Deviation</th><th>Medium (Reference)</th><th>Standard Deviation (Reference)</th><th>Ratio Sharpe</th><th>Ratio Sharpe (Reference)</th></tr>
<tr><td>Ardour Global Alternative Energy</td><td rowspan="2">MSCI World</td><td>5.1663</td><td>29.6214</td><td rowspan="2">7.9580</td><td rowspan="2">12.7490</td><td>0.1568</td><td rowspan="2">0.5832</td></tr>
<tr><td>Ardour Global Alternative Energy Extra Liquid</td><td>5.1427</td><td>31.5790</td><td>0.1463</td></tr>
<tr><td>FTSE Environmental Opportunities Renewable and Alternative Energy 50 Index</td><td>FTSE All World</td><td>1.5640</td><td>17.3503</td><td>7.2900</td><td>12.8992</td><td>0.0600</td><td>0.5246</td></tr>
<tr><td>Ardour Global Alternative Energy Solar</td><td rowspan="2">MSCI World</td><td>-0.3646</td><td>61.5850</td><td rowspan="2">7.9580</td><td rowspan="2">12.7490</td><td>-0.0144</td><td rowspan="2">0.5832</td></tr>
<tr><td>World Renewable Energy</td><td>29.9050</td><td>31.7931</td><td>0.9242</td></tr>
</table>

S&P Global Alternative Energy	S&P Global 1200	-0.1940	30.1901	10.6850	12.9869	-0.0237	0.7825
S&P Asia Pacific LargeMidCap Carbon Efficient Index	S&P Asia Pacific BMI (USD)	7.6840	13.8538	7.4970	14.0408	0.5169	0.4967
BNP Paribas Global Renewable Energies Price Return Index	MSCI World	-0.1396	29.6625	7.9580	12.7490	-0.0223	0.5832
NASDAQ Renewable Edge U.S. Liquid	NASDAQ Composite Index	9.1774	35.8738	15.5548	14.5799	0.2412	1.0310
S&P Global Clean Energy	S&P Global 1200	-6.6360	25.1097	10.6850	12.9869	-0.2851	0.7825
European Renewable Energy	DJ Eurostoxx	10.4400	40.1336	3.1560	13.3989	0.2471	0.1965
Wilderhill New Energy Global Innovation	MSCI World	2.3125	28.3624	7.9580	12.7490	0.0631	0.5832

Source: Own elaboration

Table 5. Regional DJSI. Five-factor model of Fama and French

DJSI	MRP	SMB	HML	RMW	CMA	A	R^2
DJSI World Sustainability Composite	0.7827*** (0.1307)	0.1544 (0.3377)	0.5595 (0.4398)	1.0975 (0.5711)	-0.2842 (0.7139)	0.0020 (0.0326)	0.7956
DJSI Europe	0.9496*** (0.0268)	-0.3038*** (0.0654)	-0.3859** (0.1580)	-0.5120* (0.1887)	0.2762 (0.1580)	-0.0101 (0.0078)	0.9952
DJSI North America	0.8926*** (0.0910)	0.0226 (0.2057)	0.2981 (0.2450)	0.3118 (0.2250)	-0.4229 (0.3880)	-0.0159 (0.0187)	0.9317
DJSI Asia Pacific	0.5864** (0.1716)	0.1519 (0.6984)	0.3615 (0.5003)	-0.3752 (0.6355)	-1.6632 (0.8625)	0.1234* (0.0501)	0.5702
S&P Global 1200	0.9616*** (0.0344)	-0.1652 (0.0888)	0.0815 (0.1157)	0.1061 (0.1502)	-0.0593 (0.1878)	0.0035 (0.0086)	0.9898
S&P Europe 350	0.9942*** (0.0190)	-0.2547*** (0.0464)	-0.0933 (0.1121)	0.0960 (0.1339)	0.2530* (0.1121)	-0.0110 (0.0055)	0.9978
S&P 500	0.9792*** (0.0237)	-0.2300** (0.0536)	0.0169 (0.0638)	0.0427 (0.0586)	0.0352 (0.1010)	0.0077 (0.0049)	0.9956
S&P Asia Pacific BMI	0.8849*** (0.1440)	0.5012 (0.5859)	-0.0663 (0.4197)	0.0052 (-0.5332)	-0.7227 (0.7236)	0.0671 (0.0420)	0.7964

Significant to 1% ** Significant to 5% * Significant at 10%.

4.2 Renewable index and frame of reference

We now focus on the environmental factors within sustainability using the renewable energy index (Table 6).

MRP, or systematic risk, is the critical factor in the renewable and DJSI index investors. All indexes have a significant relationship with expected profitability, except for the BNP Paribas Global Renewable Energies Price Return Index and European Renewable Energy index. The MRP values are high and often above one. In indexes such as the S&P Asia Pacific LargeMidCap Carbon Efficient Index or European Renewable Energy, MRP is below one, denoting lower volatility to the reference market. The Ardour Global Alternative Energy Solar and NASDAQ Renewable Edge US Liquid Index have the highest systematic risks (3.7156 and 2.4354, respectively). In contrast, the conventional reference index behavior shows betas below one, except the NASDAQ Composite Index (1.1173).

Regarding the alpha factor, we only find two sustainable indexes with a positive alpha factor: S&P Asia Pacific LargeMidCap Carbon Efficient Index and European Renewable Energy index (0.0716 and 0.1738, respectively). These indexes also report an MRP below one. The conventional index also reports positive returns.

Regarding the size factor, or SMB, there is no significance in any of the indexes analyzed. The relationships are largely in the negative direction. This relationship indicates that the index is made up of highly capitalized companies, except for the S&P Asia Pacific LargeMidCap Carbon Efficient Index and the European Renewable Energy index which report positive values. The reference indexes exhibit very similar performance. Based on these results, we reject our third hypothesis: renewable companies are small and growing enterprises.

The results for the HML factor are mixed. Six of the 12 renewable indexes have positive values, that is, they are composed of “value companies.” However, for the reference indexes, all HML values are negative. The significance of this factor is null.

Next, we move on to the remaining two factors. For the profitability factor, or RMW, the results are not statistically significant. The values are negative for all renewable indexes (unprofitable companies), except the World Renewable Energy Index and the S&P Asia

Pacific LargeMidCap Carbon Efficient Index (3.7953 and 0.0622, respectively). The results are different for conventional indexes. Three of the six indexes have positive values. As for the investment factor, or CMA, there are significant results for three of the 12 sustainable indexes: the FTSE Environmental Opportunities Renewable and Alternative Energy 50 Index, World Renewable Energy Index and S&P Global Clean Energy Index. Values are negative except for the World Renewable Energy and the European Renewable Energy indexes. This means that companies do not have high investment rates (conservative companies), unlike benchmarks, where investment is more aggressive.

Similar to the regional DJSI indexes, we reject H_{10} for renewable indexes and accept the alternative (H_{1a}). Therefore, in line with Sadorsky (2012a) and Rezec & Scholtens (2017), we find that sustainability and renewable energy indexes underperform or perform like conventional indexes.

Table 6. Renewable index. Five-factor model of Fama and French

Renewable index	MRP	SMB	HML	RMW	CMA	A	R^2
Ardour Global Alternative Energy	1.7205** (0.5187)	-1.2593 (1.3407)	0.4270 (1.7463)	-2.4409 (2.2674)	-2.6879 (2.8345)	-0.0195 (0.1294)	0.8018
Ardour Global Alternative Energy Extra Liquid	1.7793** (0.6128)	-1.4330 (1.5838)	0.4640 (2.0630)	-2.6505 (2.6787)	-2.7159 (3.3486)	-0.0172 (0.1529)	0.7576
FTSE Environmental Opportunities Renewable and Alternative Energy 50 Index	1.0507*** (0.2075)	-0.6877 (0.5362)	0.4274 (0.9685)	-1.1626 (0.9069)	-2.1498* (1.3370)	-0.0363 (0.0518)	0.9052
Ardour Global Alternative Energy Solar	3.7156** (1.2205)	-1.0112 (3.1545)	-0.2549 (4.1089)	-1.1801 (5.3351)	-4.0664 (6.6695)	-0.3350 (0.3045)	0.7489
World Renewable Energy	1.5770* (0.7382)	-1.3040 (1.9080)	-3.4985 (2.4852)	3.7953 (3.2269)	6.9425* (4.0340)	-0.1150 (0.1842)	0.6593
S&P Global Alternative Energy	1.6307** (0.5662)	-1.4345 (1.4634)	0.2534 (1.9061)	-2.0801 (2.4750)	-3.3613 (3.0940)	-0.0810 (0.1413)	0.7713
S&P Asia Pacific LargeMidCap Carbon Efficient Index	0.8785*** (0.1267)	0.5841 (0.5157)	-0.0073 (0.3694)	0.0622 (0.4693)	-0.8318 (0.6369)	0.0716* (0.0370)	0.9278
BNP Paribas Global Renewable Energies Price Return Index	1.1100 (0.8909)	-0.6265 (2.3027)	-0.5296 (2.9994)	-2.3045 (3.8945)	-1.9561 (4.8686)	-0.042 (0.2223)	0.4243
NASDAQ Renewable Edge U.S. Liquid	2.4354** (0.7169)	-0.5720 (1.6199)	-0.0569 (1.9294)	-1.4355 (1.7714)	-1.0474 (3.0552)	-0.2039 (0.1472)	0.7918
S&P Global Clean Energy	0.9265* (0.4859)	-0.8914 (1.2557)	0.5745 (1.6357)	-1.6466 (2.1238)	-4.5298* (2.6550)	-0.0784 (0.1212)	0.7512
European Renewable Energy	0.7981 (1.3261)	1.1735 (3.2419)	-4.8364 (7.8286)	-5.8827 (-9.3468)	3.7254 (7.8251)	0.1738 (0.3841)	0.2714

Wilderhill New Energy Global Innovation	1.7700* (0.4530)	-0.6928 (1.1708)	0.556 (1.5250)	-1.13645 (1.9801)	-2.6856 (2.4754)	-0.0890 (0.1130)	0.8357
FTSE All World	0.9441*** (0.0252)	-0.1626* (0.0652)	-0.0135 (0.0850)	0.0676 (0.1103)	0.0339 (0.1379)	0.0233** (0.0063)	0.9974
S&P Global 1200	0.9586*** (0.0720)	-0.1347 (0.1860)	-0.0492 (0.2423)	-0.0122 (0.3146)	0.0104 (0.3933)	-0.0290 (0.0180)	0.9807
S&P Asia Pacific BMI	0.8849*** (0.1440)	0.5012 (0.5859)	-0.0663 (0.4197)	0.0052 (0.5332)	-0.7227 (0.7236)	0.0671 (0.0420)	0.9049
NASDAQ Composite Index	1.1173*** (0.0656)	-0.2043 (0.1483)	-0.1396 (0.1766)	-0.2738 (0.1622)	-0.2214 (0.2797)	0.0056 (0.0135)	0.9893
DJ Eurostoxx	0.7829** (0.2067)	-0.1529 (0.5053)	-2.0888 (1.2202)	-1.9104 (1.4569)	1.8580 (1.2197)	0.01580 (0.0599)	0.8397
MSCI World	0.9441*** (0.0252)	-0.1626* (0.0652)	-0.0135 (0.0850)	0.0676 (0.1103)	0.0339 (0.1379)	-0.2330** (0.0063)	0.9974

Significant to 1% ** Significant to 5% * Significant at 10%.

4.3 Risk – return ratio

We have seen how investors' most significant factor is the MRP factor or systematic risk. This factor is closely related to the alpha factor or the index profitability. A beta below one and a high return give us a way to consider an attractive investment. Investors facing these positions are averse to risk (Fama & French, 2015). To clarify and consider both factors as the most representative, in Table 7, we analyze the values extracted for the MRP and alpha factors in percentage.

The reported data show that the sustainable indexes with positive returns are DJSI World Composite and DJSI Asia-Pacific. The latter stands out with a return of 12.34% and a statistical significance of 10%. The alpha factor is higher in the conventional index, except for DJSI Asia-Pacific. Sustainable indexes are accompanied by a beta less than one. Therefore, based on volatility, they are not risky assets compared to the benchmark market.

Table 7. Return ratio – risk in DJSI and renewable index

DJSI	Alpha 5 factors %	Beta 5 factors	R^2
DJSI World Sustainability Composite	0.2	0.7827***	0.7956
DJSI Europe	-1.01	0.9496***	0.9952
DJSI North America	-1.59	0.8926***	0.9317
DJSI Asia Pacific	12.34*	0.5864**	0.5702
S&P Global 1200	0.35	0.9616***	0.9898

S&P Europe 350	-1.10	0.9942***	0.9978
S&P 500	0.77	0.9792***	0.9956
S&P Asia Pacific BMI	6.71	0.8849***	0.7964
Renewable index	**Alpha 5 factors %**	**Beta 5 factors**	**R^2**
Ardour Global Alternative Energy	-1.95	1.7205**	0.8018
Ardour Global Alternative Energy Extra Liquid	-1.72	1.7793**	0.7576
FTSE Environmental Opportunities Renewable and Alternative Energy 50 Index	-3.63	1.0507***	0.9052
Ardour Global Alternative Energy Solar	-33.46	3.7156**	0.7489
World Renewable Energy	-11.53	1.5770*	0.6593
S&P Global Alternative Energy	-8.07	1.6307**	0.7713
S&P Asia Pacific LargeMidCap Carbon Efficient Index	7.16*	0.8785***	0.9278
BNP Paribas Global Renewable Energies Price Return Index	-4.18	1.1100	0.4243
NASDAQ Renewable Edge U.S. Liquid	-20.39	2.4354**	0.7918
S&P Global Clean Energy	-7.84	0.9265*	0.7512
European Renewable Energy	17.38	0.7981	0.2714
Wilderhill New Energy Global Innovation	-8.86	1.7700*	0.8357
FTSE All World	2.33**	0.9441***	0.9974
S&P Global 1200	-2.91	0.9586***	0.9807
S&P Asia Pacific BMI	6.71	0.8849***	0.9049
NASDAQ Composite Index	0.56	1.1173***	0.9893
DJ Eurostoxx	1.58	0.7829**	0.8397
MSCI World	-23.3**	0.9441***	0.9974

Significant to 1% ** Significant to 5% * Significant at 10%.

By benchmarking conventional indexes, we see how the benchmarks have a higher beta factor than those reported by conventional indexes.

Regarding renewable indexes, the S&P Asia Pacific LargeMidCap Carbon Efficient Index and European Renewable Energy are the only renewable indexes with positive returns (7.16% and 17.38%, respectively). The rest reports negative alpha factors. Therefore, we reject the second null hypothesis (H_{20}) in favor of the alternative hypothesis (H_{2a}). That is, the sustainable and renewable indexes underperform or like the conventional indexes.

5. Discussion

The main goal of this research was to answer two questions: can investors in sustainable indexes and renewable energy indexes expect a return according to their risk level? Is it more cost-effective to invest in sustainability and renewable energy indexes than conventional indexes? Two hypotheses were constructed to address these two questions. The empirical results show that investing in sustainable indexes is not attractive, except for the DJSI World and DJSI Asia Pacific, which are not suitable for investors' optimal investment alternatives (Sadorsky, 2012a; Rezec & Scholtens, 2017; Reboredo et al., 2017). Consequently, both hypotheses are rejected.

The beta coefficient of the sustainable indexes is close to one. The average beta for the sustainable index is 0.7905, which is less volatile than the conventional index with an average beta of 0.9463. Sustainable companies are highly capitalized and valuable entities that have a negative momentum in their profitability. The SMB factor or size factor is not significant. This contrasts with Sokolovska & Kešeljevic's (2019) findings, who report significance in the factor for under – capitalized companies. The non-significance of this factor could be because the companies are highly capitalized.

Regarding alpha, DJSI World and DJSI Asia Pacific report positive alphas (0.0417 and 0.0287, respectively). These data are corroborated by previous literature, which identifies a low risk and a positive oversized return (Chia et al., 2009; Fang et al., 2020). Others, such as Rezec & Scholtens (2017), find that sustainable companies are less attractive for investors. This supports our conclusions for indexes such as DJSI North America or DJSI Europe.

For variables other than systemic risk, the five – factors model offers significant results only for the European sustainable indexes. Our results show that for DSJI Europe, the variables SMB, HML and RMW are significant. The European Sustainable Index companies have large capitalization with a market value exceeding book value and with negative operating profitability. As Fama & French (2015) demonstrate, large – cap companies are less profitable than small – cap companies. The lower annual return for this index than conventional ones may be because of investors discounting the overvaluation of the market and negative operating results.

Next, we consider RMW and CMA. The profitability or RMW factor has mixed results.

Companies are profitable only in the DJSI World and DJSI North America indexes. This fact does not give us absolute certainty that sustainable companies are profitable only because they are sustainable (Sokolovska & Kešeljevic, 2019). Regarding CMA, sustainable companies do not invest aggressively. The positive relationship between investment and profitability cannot be corroborated (Cedrick & Long, 2017). Authors such as Safarzynska & van den Bergh (2017) and Wiser & Pickle (2017) provide evidence that very high investment can lead to negative returns on companies and financial instability that increases financing costs.

For renewable energy indexes, the systematic or beta risk is very high compared to conventional benchmarks. This denotes that the former are very unattractive investments. Beta is significant for all indexes except for the BNP Paribas Global Renewable Energies Price Return Index and the European Renewable Energy Index. Companies are highly capitalized and have good momentum for their performance. The results are mixed for the HML factor or value, we find both “value companies” and “growth companies.” These results are in line with Lopez et al. (2007a, 2007b) and Sokolovska & Kešeljevic (2019). The RMW factor or profitability factor denotes that most indexes are made up of unprofitable companies. According to the investment factor or CMA, renewable companies do not invest substantially. The relationship between investment and performance is not favorable. These results contrast with those of Currier (2015) and Justice (2009).

The positive risk – return relationship is not found in our results. We see low and even negative returns, accompanied by beta values above one. The attractiveness of the investment is null. This result seems to refute the common belief that there is a positive relationship between risk and return. Thus, our findings provide support for the theoretical framework of Bowman’s paradox (Núñez & Cano, 2002).

The results also do not demonstrate the “green premium” (sustainable and renewable indexes outperform conventional indexes), except for the following indexes: DJSI World Sustainability Composite, DJSI Asia Pacific, S&P Asia Pacific LargeMidCap Carbon Efficient Index and European Renewable Energy Index. Recently, Fang et al. (2020) do find a green premium for a set of sustainable companies belonging to the Chinese Stock Exchange.

6. Conclusions and implications

Here, we used Fama & French's (2015) five – factors model to examine a set of sustainable indexes and a wide range of renewable energy indexes, being the latter a subject little used in the previous literature. The main conclusion is that investments in sustainability and clean energy listed companies are risky and unprofitable.

Owing to the large sample size and the focus on clean energy indexes, we can demonstrate that the environmental dimension is less attractive (lower profitability and more risk) than the sustainability dimension. The beta coefficient of renewable energy indexes is significant and high, being above one in many cases. These positive beta values,
accompanied by a negative alpha factor, mean that renewable energy investments are unattractive. Nevertheless, we provide evidence that for Asian and European companies, investment in renewables and sustainability offers a good risk – return ratio. The DJSI indexes also provide an acceptable risk – return ratio.

Compared with conventional indexes, we note that the DJSI indexes report a lower systematic or beta risk. Even prevailing returns outperform conventional indexes, except for DJSI North America. Regarding renewable energy indexes, the risk – return ratio is more attractive than conventional benchmarks.

These results show that investment in clean energy may not be an appropriate alternative for private investors. It seems that investors will not be willing to commit their resources to clean energy investments compared to the current benchmark investments. The latter are better known, and therefore, are less risky. Thus, currently, the risk – return relationship seems insufficient. This means that public administrations must exert a large effort to reach a satisfactory solution that facilitates the arrival of more resources to the system at a lower cost. That is, clean energy investments with large alphas and low betas.

Therefore, governments in different countries or regions must provide significant capital
to make clear energy investments more profitable. Then, the industry will grow exponentially, and private investment will positively respond to the transition to clean energy (Gamel et al., 2016; Wüstenhagen & Menichetti, 2012). A recent example of public initiatives is the "Great Green European Pact." This is an initiative that falls within

the 2030 Agenda of the United Nations (United Nations, 2019) to transform the EU into an equitable society with a modern economy, efficient resource usage and no net greenhouse gas emissions in 2050 (European Commission, 2019).

Our study does have some limitations. First, we stick to Fama and French's five – factors model. This limits us from checking the goodness of the model against others, such as Carhart's four – factors model. Future research can address this issue and use a variety of models. Second, both the sample and the period analyzed can be extended to accommodate more data, besides considering more complex methods such as multiple time series analysis. Third, future research should cover aspects such as the study of relevant historical facts (the COVID – 19 pandemic) and their interaction with renewable energy (Arefeen & Shimada, 2020), the valuation of investments for a specific type of renewable energy (Ciarreta et al., 2014; Tagliapietra et al., 2019) and the analysis of direct government policy outcomes for a given region or country (Meadowcroft, 2009).

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CHAPTER V. CONCLUSIONS

1. Conclusions

1.1 Summary of results and conclusions

The main objective of the thesis is to contribute to the knowledge about the economic – financial impact of sustainability and CSR strategy in the O&G industry. Framed in a period of energy transition, it is becoming increasingly urgent to know what this change implies for the energy industry and, more specifically, for the O&G industry as the main agent of this change. After an introduction of the question, the thesis consists of a total of three chapters that deal with the subject mentioned. Chapters 2 and 3 discuss the relationship between sustainability, as measured by ESG factors, and the corporate financial strategy and market value of O&G companies. To this relationship, ESGC is added as a moderating variable to check if the negative events published in the press about bad CSR practices affect the relationship between ESG factors and financial performance within the study industry. Once it has been verified that there is a positive and significant relationship between ESG factors and financial performance, and that there is a moderation effect of ESGC, Chapter 4 frames the thesis in the context of the energy transition. To this end, for a set of stock market indices, it is confirmed that financial markets do not yet consider investment in renewable energy indices attractive according to the risk – return ratio.

In relation to the core of the thesis, Chapter 2 contributes to the knowledge of the ESG – corporate financial strategy link of O&G companies. To this end, it aims to test how the CSR profile influences, through the ESG index, the corporate financial strategy understood as a set of representative magnitudes of said strategy, such as financial performance, market risk and market value. Additionally, the creation of a new ESG index is proposed, so that the chapter aims to provide a more objective construction of the latent variable (with the simultaneous study of the Environmental, Social and Governance factors) representative of the CSR profile shown by O&G companies, offering, therefore, a concise answer to how this profile affects the corporate financial strategy of the industry. To achieve these objectives, Chapter 2 employs a statistical approach based on the Structural Equations Modeling by Partial Least Squares (PLS-SEM) applied to a sample of 219 global O&G companies by 2020.

The main results and conclusions drawn are as follows: (1) The factors that have a significant weight on the formation of the ESG index are Environmental and Governance; (2) Greater commitment to the Environmental factor results in better financial results for O&G companies; (3) A higher level of CSR has an impact on a reduction in financial risk, thus contributing to an increase in market confidence; (4) Financial performance is significantly more important than market risk, recognizing this risk already in the intrinsic nature of ESG factors; (5) The incorporation of the ESG profile has a considerable influence when the market analyses the value of an O&G company.

Chapter 3 of this thesis aims to analyze the moderating effect of ESGC on the relationship between ESG factors and market value. Unlike Chapter 2, Chapter 3 considers ESG factors separately. While in that ESG pillars are represented by a single construct, Chapter 3 disseminates this construct into three (Environmental, Social and Governance). In this way, it allows us to identify if there is a moderating effect of ESGC for each of the pillars and their relationship with market value. Within the statistical approach of Structural Equations Modeling, for this chapter the analysis of compounds based was used. A compound analysis that has the advantage that each construct (ESG pillar) is completely formed by its indicators or observable variables. The study sample consists of a total of 264 global O&G companies with data from 2019.

The main results and conclusions drawn are as follows: (1) The Environmental and Social pillars have a positive and significant impact on CFP; (2) ESGC have a significant negative impact on CFP; (3) ESGC have a moderating effect on the Environmental – CFP link and Social – CFP link; (4) An increase in negative media events reduces the positive effect on the relationship between Environmental and Social sustainability and CFP, making the CSR strategy less financially efficient; (5) With regard to the ESG pillars developed, it can be seen that:

- Of the three indicators that make up the Environmental pillar, the most relevant indicator was gas emissions (E2=0.70).
- Of the four indicators that make up the Social pillar, the most relevant indicator was the labor force (S1=0.55).
- Of the three indicators that make up the Governance pillar, the most relevant indicator was the CSR strategy (G3=0.81).

Chapter 4 aims to examine the attractiveness of sustainable and renewable energy indices compared to investing in conventional indices for investors, thereby contributing to a better understanding of the stance of international financial markets towards the energy transition, and how they assess it from a risk – return perspective. To achieve this objective, Chapter 4 has provided data for a total of 30 international stock market indices (16 sustainable and renewable energy and 14 conventional) framed in the period 2011 – 2019.

The main results and conclusions drawn are as follows: (1) The market beta for renewable energy indices is significantly high, making it a high – risk industry from an investment point of view. This, accompanied by negative values of the Alpha factor (returns), makes investment in renewable energy not sufficiently attractive at the time of the investigation; (2) The risk – return ratio in renewable energy indices is less attractive (high risk, low return) compared to conventional indices; (3) DJSI indices report a lower market beta than conventional indices, and a higher alpha factor, except for DJSI North America. This makes it have an acceptable risk – return ratio; (4) Indices with an Environmental dimension (renewable energy indices) are less cost – effective and riskier than indices with a general sustainability dimension (DJSI).

1.2 Contributions and implications for theory and practice

The main theoretical – practical contributions that are extracted from the results obtained throughout the thesis will be highlighted. The impact, possible consequences and influence of these results are detailed in each chapter. However, this section provides a detailed and careful summary of the most relevant aspects regarding: (1) how the thesis contributes to the development and theoretical discussion of the issue; and (2) what are the implications of the results obtained for the O&G industry and the strategic position it occupies within the energy transition.

1.2.1 Discussion of theoretical contributions and their implications

Given the scarce previous literature specialized in the study of ESG factors on corporate financial strategy in the O&G industry, this thesis tries to provide a more focused vision on how O&G companies can benefit from responsible practices within the framework of their global corporate strategy. The contribution that the CSR profile has on the increase in the value of O&G companies, the reduction of market risk and the improvement of their financial performance, is of great interest for theoretical purposes since the research community needs empirical studies that demonstrate that a more sustainable company can also obtain economic – financial benefits in industries with a considerable negative impact, as the one studied in the development of this thesis.

The research carried out in Chapter 2, unlike the previous literature, examines a set of multiple economic – financial variables (ROA, ROE, market value, market price, beta, and Sharpe ratio) that can be affected by ESG factors. Detailed information is provided on how these factors influence financial performance, market risk and market value.

Research suggests that markets are influenced by the actions that O&G companies carry out at the environmental and corporate governance level, which supports previous contributions such as those of Miralles – Quirós et al. (2019), Shakil (2021) or Shanaev & Ghimire (2021). Being the Governance factor, it is not as significant as the Environmental factor, the latter being considered as the most influential in the explanation of the ESG index. Considering that the analysis supports a positive and significant relationship of the ESG index on the market value in O&G companies, the results are in line with authors such as Tzouvanas & Mamatzakis (2021), who also found this relationship between the Environmental factor and market value. This positive relationship is also found on financial performance confirming that, through environmental strategy, O&G companies can improve their financial results, which is in line with what is suggested by authors such as López-Toro et al. (2021) for the pharmaceutical industry. On the other hand, the relationship is negative when ESG factors are related to market risk, as indicated by Dilling & Harris (2018) or Shakil (2021). This means that a greater emphasis on environmental and governance policies improves market confidence in O&G companies. In turn, the influence of financial performance and market risk on market value is tested. Thus, although both variables influence the market value (Bodhanwala & Bodhanwala, 2020; Tzouvanas & Mamatzakis, 2021), market risk has a considerably smaller impact on such a value. This may be because investors already consider the sustainable profile as an indicator of risk, no longer being treated as a peripheral issue to become a key player when valuing O&G companies (Champagne et al. 2021).

Chapter 3 focuses on the moderating effect of ESGC on the relationship between the CSR of O&G companies and their market value. The previous study of this moderating effect in the O&G industry is very scarce. Once the previous literature review has been carried out, the article by Shakil (2021) is identified as the only work that introduces the moderating effect of ESGC on the relationship between ESG factors and financial risk in O&G companies. In fact, this work is limited by three issues: (1) the data on which it is based for the measurement of ESG factors are extracted directly from the database, without considering that there may be indicators that contribute more or less to the score of each factor, as can be seen in the results extracted in Chapter 3, where, for example, gas emissions contribute more to the explanation of the Environmental construct with respect to indicators such as the use of resources or environmental innovation; (2) focuses on financial risk, not being able to observe the moderating effect that ESGC could have on the CSR relationship and the value of the company; (3) because it studies the ESG index as a single variable, thus not delving into the study of each pillar, it does not allow to identify the possible moderating effect of ESGC on the relationship that each pillar (Environmental, Social and Governance) has with financial risk. For these limitations, the thesis develops in Chapter 3 a deeper study on the moderating effect on the CSR – value of the company link. The results extracted allow us to confirm that: a reduced number of negative events published in the media will allow environmental and social policies to contribute more to the increase in the market value of O&G companies, compared to those that may be affected by a greater number of negative events published (Aouadi & Marsat, 2018; DasGupta, 2021). Shakil (2021) is in line with this result, as he also argues for a moderating effect of ESGC on the relationship between the ESG index and financial risk. Others such as Nirino et al. (2021) demonstrate that there is a negative and significant relationship between ESGC and financial performance for a set of European companies, although the moderating effect is not demonstrated in their analysis.

So far, Chapters 2 and 3 have focused on the O&G industry, analyzing the sustainability – corporate financial strategy link and the moderating role that ESGC play in this relationship. Both chapters are framed in the current energy transition period, therefore, and once it has been demonstrated that O&G companies can benefit financially from being more sustainable, Chapter 4 tries to respond to how attractive (according to the risk – return ratio) is for international markets the investment in sustainability and renewable energy compared to conventional investment. With a sample of 24 international stock market indices (4 sustainable indices; 12 renewable indices; 8 conventional indices) and covering a period of 9 years, Chapter 4 contributes to a clearer and more global vision of the risk – return ratio in investment in sustainability and renewable energy, and how it behaves with respect to conventional indices. This allows us to contrast to a greater extent the contradictory results existing in the previous literature, due to issues such as the chosen sample, the period or the econometric models applied (Mazzucato & Semieniuk, 2018). As a result of the analysis, the chapter concludes that investors do not find it attractive to invest in renewable energy indices as they report higher risk and underperformance than conventional indices. In line with these results, authors such as Sokolovska & Kešeljević (2019) suggest, for a sample of 7 renewable energy indices, that these indices are not financially attractive due to the risk – return ratio they report. Others such as López et al. (2007) also support, through the comparative study between the Dow Jones Sustainability Index (DJSI) and the Dow Jones Global Index (DJGI), that there is a short – term negative impact between CSR practices and financial performance. However, with the recent work of Fang et al. (2020), the existence of a "green inspiration effect" has been demonstrated that allows green industries to have a higher average profitability compared to conventional industries.

Thanks to the results obtained throughout the thesis, it is demonstrated that sustainability allows to increase market value, reduce risk, and generate greater economic and financial profitability for O&G companies. With these conclusions we can cover the gap identified in the previous literature, contributing to the existing theory with a new, deeper, focused, and representative approach to sustainable management and its economic – financial impact in the O&G industry. However, this positive impact is not yet perceived by international markets, since they do not consider investment in sustainability and alternative energy attractive from the risk – return approach. Therefore, the investment attractiveness of the energy transition is very small, which implies a series of practical consequences in which we will deepen below.

1.2.2 Discussion of practical contributions and their implications

After extracting the main results of the thesis, possible business and government strategies could be identified to reduce the environmental and social impact of the O&G industry globally. As can be seen during the development of the thesis, the implementation of sustainable practices from the environmental, social, and governance point of view contribute to O&G companies benefiting from the increase in market value, the decrease in risk and the improvement in financial performance. In this way, the benefits of being more sustainable not only result in a reduction of the negative environmental and social impact, but also an economic – financial improvement of the industry. However, investors do not finish positively evaluating the advantages of investing in indices formed by companies committed to sustainability.

From the environmental point of view, issues such as the efficient use of resources, the reduction of CO_2 emissions or environmental innovation are of great importance to maintain an optimal level of environmental sustainability. For this, a more efficient use of resources is required in the extraction of oil or gas through innovative technologies that reduce CO_2 emissions and the use of natural resources (such as excessive water consumption in the fracking technique). Regarding the Social and Governance dimensions, employee management, product responsibility, corporate governance management or CSR strategy are the indicators that most influence these dimensions and on which O&G companies should focus to increase the level of social responsibility and good governance. The implementation of these practices, as has been seen during the development of the thesis, is accompanied by economic and financial benefits, reflected in the market value of these companies. Financial markets begin to account for CSR profile management, even giving more importance to these issues than to financial market risk. However, the market still does not provide a positive and concise response to sustainable investment and, more specifically, to investment in renewable energy. Therefore governments and international public institutions must take a more active role and implement new policies and regulations that allow companies to improve their environmental and social performance, so that they are also financially viable. Moreover, public regulators should pay more attention to ESG analysis to ensure companies' CSR engagement. For example, with the incorporation of international standards that allow measuring and evaluating the practices carried out by companies.

Within the framework of the necessary energy transition, this issue becomes even more important because O&G companies play a fundamental role in the energy industry and, in our view, it is they that will become the main agents of the change towards the exploitation of renewable energies and towards the decarbonization of the industry itself. Considering the positive effect of the Environmental dimension on corporate financial strategy, O&G companies can contribute to the energy transition by starting to reduce their participation in the exploitation of conventional energies and giving way to greater investment in renewable energies. This change must be accepted and corroborated by the international financial markets who, through the trust deposited, can increase their investment.

1.3 Limitations and future lines of research

While it is true that the thesis makes, in our opinion, relevant contributions to the knowledge of sustainability and its economic – financial viability within the O&G industry, it is subject to certain limitations.

As for Chapters 2 and 3, the study period is only one year, which limits the conclusions because there is no trend or evolution in this regard. On the other hand, the sample is global, which means that the selected companies may be subject to different government regulations and, therefore, the data analyzed, and the results are conditioned by this issue. Moreover, a global sample does not allow the focus on a specific region, which could contribute to increasing the depth of the analysis and even to carry out comparative studies between them. Also, in relation to the sample, once the analysis focuses on O&G companies, it no longer considers a relevant part of the energy industry, such as renewable energy or nuclear companies. A sample with a longer period, focused on one or more specific regions and considering the entire energy industry, could provide a more concise view of the effect of ESG factors on the corporate financial strategy of the sample, which is a challenge for our future research.

Regarding Chapter 4, the use of a single statistical model (Fama & French 5 – factors model of Fama and French) limits the robustness of the results and does not allow contrast with other models such as Carhart 4 – factors model. On the other hand, as the sample refers to stock market indices, the study does not allow to delve into the companies that are part of each index or the kind of industry to which they belong. In addition, it is well known that the market reacts sharply to certain events that happen globally of a political, economic, or social nature. These kinds of key moments were not considered during the analysis carried out in Chapter 4. A more in – depth analysis of the sample (through the study of a small number of indices and the companies that form it), using two models to improve the robustness of the results and considering the relevant events that have occurred in recent years (for example: the financial crisis of 2008, the COVID – 19 crisis or the recent war in Ukraine), they can be solutions to be taken into account in order to extract results of interest for investment in sustainability and renewable energy as a profitable option compared to conventional investment, thus opening a line of research to be developed.

The thesis has identified that environmental sustainability in the O&G industry is positively related to corporate financial strategy. However, the market does not consider this relationship profitable, since at present it is not attractive to invest in sustainability and renewable energies for the purposes of risk – return. This gap between the relationship between environmental sustainability – corporate financial strategy and the reality in the financial markets, allows us to identify a line of research framed in the O&G industry and in the energy transition. Through the level of investment in renewable energy by O&G companies, and its relationship with market acceptance to invest in them, it will allow us to observe in greater depth whether investors really consider the energy transition towards renewable energies attractive. In this way, it will be possible to combine the Socially Responsible Investment (SRI) approach with the environmental sustainability strategy by O&G companies, which generates another line of research in the future.

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