LISBON
SCHOOL OF
ECONOMICS &
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UNIVERSIDADE DE LISBOA

MASTER

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MASTER'S FINAL WORK

DISSERTATION

A COMPARATIVE ANALYSIS BETWEEN GREEN AND CONVENTIONAL FUNDS' PERFORMANCE

DIEGO GOMES PIMENTEL

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SUPERVISION:

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GLOSSARY

CAC 40 – Cotation Assistée en Continu 40 index

CAPM – Capital Asset Pricing Model

CEPR – Centre for Economic Policy Research

COP 21 – 21st Conference of the Parties in Paris

CSR – Corporate Social Responsibility

DAX 30 – Deutscher Aktien Index 30 index

ESG – Environmental, Social and Corporate Governance

EU – European Union

FP – Financial Performance

GDP – Gross Domestic Product

HML – High minus Low

MKT – Market

MOM – Momentum

OECD – Organization for Economic Co-operation and Development

ROA – Return on Assets

S&P 500 – Standard & Poor's 500 Index

SMB – Small minus Big

SRI – Socially Responsible Investments

US – United States

ABSTRACT

This paper aims to analyze how the risk-adjusted returns of green funds are compared to the risk-adjusted returns of conventional funds between the years 2005 and 2020 for the European Union countries. Additionally, we have tested how the performance of green funds correlates to the business cycle, subdividing their performance through expansionary and recessionary times.

The findings of this paper are summarized as follows: Our regression results demonstrate green and conventional funds exhibiting negative abnormal adjusted-returns against the developed world market benchmark for the single-factor and multifactor models. For the European market benchmark, we find environmental mutual funds presenting a positive performance for both models and conventional funds displaying negative results for the single-factor model and positive results for the multifactor model. The factor loadings findings for green funds indicate a negative load on Momentum, HML and SMB, revealing a higher exposure to big and value companies. Subsampling per business cycle exhibits green mutual funds providing higher risk-adjusted returns to investors during crisis periods and mixed results for the non-crisis periods.

KEYWORDS: ESG; Green Funds; Conventional Funds; Performance; Sustainable; Investments.

JEL CODES: E32; F30; G11; G15; G23; M14.

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1. INTRODUCTION

The increasing awareness about sustainability has led green investments to gain popularity among investors, especially after the COP 21 Paris Agreement and the UN Sustainable Development Goals, both aiming to tackle climate change and its effects on the planet and, therefore, on human life, environment, and economy.

Companies are directly affected by these changes, and they have reevaluated their behavior to meet new demands of the financial market. Investors and institutions are also realigning their asset allocation, given that sustainable firms are better attuned to endure through hard times, and by so, offer steady risk-adjusted returns through time. Following this new trend, investment banks and asset management have increased their supply of green funds over the recent years, providing many options for investors screening ESG (Environmental, Social and Corporate Governance) aspects on their portfolio allocation decision.

Although there is empirical evidence of the increased availability of environmental funds, no consensus is reached on the risk-adjusted returns tendency between green and conventional funds. Some results show better risk-adjusted returns for green funds and others for their conventional peers. Our study takes this opportunity to fill the literature gap by analyzing new data for green and conventional funds returns, ensuring if there is an upward tendency for green funds to outperform over time or if the classical conventional funds are still the ideal choice.

To understand whether or not the relationship between green and conventional funds returns holds in different economic scenarios, we also study their behavior over the business cycle. We intend to identify funds' performance over expansion and recession periods, assessing if there is a relevant correlation with the economic cycle.

We used Thomson Reuters Eikon to select the funds for our analysis, then we extracted the data using Bloomberg, considering the period from January 2005 to May 2020. The pricing models used to evaluate the risk-adjusted returns between funds are the CAPM (Capital Asset Pricing Model) single-factor and the multifactor Carhart (1997) model. The multifactor model is applied to expand our analysis as it considers four factors to assess the risk-adjusted performance of mutual funds.

Our sample comprises 137 green and 763 conventional funds domiciled in European Union countries. Over a third of the green funds on our sample have been established since 2016, and almost 60% of them have been established in the last ten years. Conventional funds have had 18% established since 2016 and an increase of 42% over the past ten years.

The calculation of funds returns means confirms the upward tendency for green funds. In the first half of our period, we have conventional funds outperforming their peers with a 2,9% premium. The results change considerably over the last eight years of our sample, with green funds paying a 5% premium. For 16 years of our sample, we have an average of 4,21% per year for sustainable investments, contrasted to 4,08% on average for conventional funds. When we subdivide the period into crisis and non-crisis, we find higher returns for sustainable investing, with a premium of 3,76% during crisis times and 4,02% premium for non-crisis subdivisions.

From our regressions results, we can draw some conclusions. First, we see a clear difference between green and conventional funds' performance by analyzing the single-factor regression results, with both classes of funds substantially underperforming the developed world market factor. It is, however, non-statistically significant. We find a distinct outcome using the European market factor, with green funds inverting the negative yield to a positive scenario, and conventional funds reducing its underperformance. Conventional and green funds returns are similar using the Carhart (1997) multifactor model, with negative and positive returns for the Developed world and European market factors respectively, nonetheless, without a significant improvement in the ability of the model to explain the outcome in comparison to the CAPM. The factor loadings findings reveal a negative load on Momentum and higher exposure of green funds to value and big companies. Finally, subsampling our analysis per business cycle suggests sustainable funds outperforming the market and their peers on crisis and mixed results for non-crisis periods.

This paper is divided into five chapters. The second chapter is the literature review. The third chapter exhibits data details and methodology for empirical analysis. The fourth chapter discusses the results obtained and lastly, the fifth chapter presents the conclusions of our research.

2. LITERATURE REVIEW

An individual investor has many possibilities when choosing where to invest his money (financial market, entrepreneurship, real estate, education, cryptocurrencies are among the available options). Financial Markets itself can provide a diversity of products, from fixed income and government bonds to more "exotic" options such as derivatives. Investors can choose between buying a stock/ bond and managing the portfolio themselves or buying indirectly through mutual funds offered by financial institutions.

However, to simplify their lives and make it safer, most investors decide to trust big financial institutions to manage their money through all types of mutual funds. Mutual funds are pooled investment instruments, granting liquidity and economies of scale to investors (Taivainen, 2018), providing households with an opportunity to diversify their portfolios across a broad set of markets that they otherwise could not access as retail investors (Matos, 2020). They are divided into passive and active funds. The first ones seek to track the index, risk reduction, and charge lower administration fees. The latter ones are managed continuously, targeting beating the market's benchmark index (SP 500, CAC 40, DAX 30, etc.). The point is to outperform the market, picking securities that could yield substantial returns, and by doing so, they charge higher fees. For our analysis, we are only going to consider actively managed funds.

An investor could also move beyond profitability and financial aspects, applying a stricter screening, including other non-financial aspects such as ethics, social engagement, greenhouse gas emissions, or resource depletion, when choosing a stock or a mutual fund. For Munoz-Torres, Fernández-Izquierdo, Rivera-Lirio & Escrig-Olmedo (2019), the first step for an investor is to select the screening method. It can be negative, excluding investments in some industries, or positive, identifying companies with the best practices on sustainability. Taivainen (2018) states that, although stricter screening reduces investment opportunities, it will be followed by improved selectivity opportunities.

Socially responsible investments (SRI) have been growing in terms of popularity and have become an essential phenomenon in the financial world. It follows the increased awareness on climate change brought into the mainstream by international

events such as COP21 in Paris, prompting the financial markets on the impacts environmental risks can have on long-term profitability. SRI can be described as

> *A long-term oriented investment approach which integrates ESG factors into research, analysis, and selection process of securities within an investment portfolio. It combines fundamental analysis and engagement with an evaluation of ESG factors in order to better capture long-term returns for investors and to benefit society by influencing the behavior of companies (Eurosif, 2018, p. 12)*

For Nizam (2019), investors are concerned if integrating ESG factors in the investment strategy could impact the potential long-term performance of their portfolio.

Capelle-Blanchard & Monjon (2012) complements showing that responsible investors tend to avoid investment in sin stocks (tobacco, alcohol, gambling, weapons, etc.), favoring firms committed to best practices, respecting environmental sustainability, labor conditions, and community relations. Moreover, it is more likely that they encourage shareholder engagement.

It is important to accentuate that all investors expect a return for their savings and investing in SRI will not be an act of benevolence. SRI will only be considered if their performance is, at least, tracking the market. Therefore, it is essential to enlighten past results for these investments, mainly to show that investors can do great while doing good (Hamilton, Jo & Statman, 1993).

Companies are also opting for a social responsible view in their business, as highlighted by Ferrero-Ferrero, Fernández-Izquierdo & Munõz-Torres (2016), not just because of market conditions or pressure from shareholders, but also because it is a long-term oriented business approach. Integrating ESG factors in high management decisions can generate higher and steady profits in the future for its shareholders. Fernández, Abu-Alkheil & Khartabiel (2019) explained that environmental activities could enhance resource utilization, strengthen business against competition and improve financial performance of the firm.

Dixon-Fowler (2012) argues that pollution is a waste of resources and unnecessary costs, finding empirical evidence of efficiency improvement through environmental performance, leading to a competitive advantage and improved financial performance, reducing costs and increasing innovation. Additionally, Ortas, Burritt & Moneva (2013) provide evidence that companies gain from an eco-efficiency attitude not only by cost reductions but also due to a competitive advantage of being a first

mover and decreasing overall risks. For Matos (2020), corporate exposure to environmental risks, governance issues and social practices can effectively disturb long-term firm value, as it happened in the Enron Corporation accounting fraud in 2001, the Deepwater Horizon oil spill in 2010, the Volkswagen emission scandal in 2015, and the Facebook data leaking in 2019.

Corporate sustainability emerges when companies are actively supporting sustainable development, combining their actions and practices to promote sustainable development by considering their duties to the society on the institutional, organizational and individual levels, generating social, environmental and economic value. Many agencies use ESG information for the elaboration of sustainability indexes. Those indexes are essential for investors to track financial performance of outstanding sustainability-driven firms.

Refinitiv (2019) is one agency producing ESG scores, gathering information about resources usage, greenhouse emissions, innovation, workforce, human rights, community, product responsibility, management, shareholders and Corporate Social Responsibility (SCR) strategy, based on company-reported information, updating scores on a regular basis. Those scores help us to differentiate companies, distinguishing those depleting natural resources on their way to make profits, from those working to reduce negative externalities on society and generate value to its associates.

Minutolo, Kristjanpoller & Stakeley (2019) analyzed firms in the S&P 500 from 2009 to 2015 to assess if there is a relationship between ESG scores and firm performance. The study uses the ESG database for 467 out of the 500 in the index, and the analysis established empirical evidence enlightening a strong relationship between ESG and return over assets (ROA) for the companies considered. The impact is more prominent for small and medium companies than for big companies, although it is relevant to all of them. Khan (2019) studied the relation using MSCI (Morgan Stanley Capital International) data for companies over 47 developed/emerging countries, and the results also indicated a positive correlation between the ESG score and the stock returns. Friede, Busch & Bassen (2015) compiled 2200 ESG/financial performance research papers for financial markets all over the world, finding clear evidence of a positive relation between ESG and FP (financial performance), especially for North America and Emerging Economies. Similar results were found by Ortas et al. (2013) for the Asia Pacific region.

Financial institutions are currently supplying the market with numerous funds specialized in socially responsible investments (SRI funds), funds formed by companies with high ESG scores or even funds specialized in sustainable, non-polluting and environmentally friendly companies, the so-called Green Funds. For Ibikunle & Steffen (2017), a green mutual fund is characterized as one that makes investments based on a sole commitment to environmental principles and engagements and it comprises of companies that demonstrate outstanding environmentally friendly conducts, a low impact on the environment and also involved in natural resource protection, energy efficiency activity, clean technology or renewable energy. A survey conducted by BNP Paribas (2019), with 347 asset owners and managers in Europe and America incorporating ESG into their investment decision process, found that 75% of asset owners and 62% of asset managers invest at least 25% in ESG funds. Their top motivations were improved long-term returns, brand and reputation, and decreasing investment risk. Nizam, Ng, Dewandaru, Nagayev & Nkoba (2019) found empirical evidence that performance of the financial institutions would improve when they enhanced ESG or environmental financing access.

Green funds apply multiple strict screenings, excluding companies with poor environmental performance and not committed to a sustainable business, like those from polluting industries such as fossil fuel or coal, and incorporating companies directly committed to long-term sustainability by reducing greenhouse gas emissions and global warm. It mainly comprises of companies dedicated to energy efficiency or production of renewable energy (solar, wind, biomass, nuclear and biofuels). Using this strategy, Ibikunle et al. (2017) and Fernández (2019) found that we could expect high exposure to small cap and growth stocks. Climent & Soriano (2011) concluded that, by underweighting some industries as oil and gas and overweighting others as utilities, performance funds are biased and the ability to reduce risk by diversification is restricted. Taivainen (2018) reports that although the stricter screening decreases diversification, it also makes it easier to find better options, as companies well-managed and long-term focused are those left in the pool, although green funds have a higher concentration in small companies, as green companies are still ramping up.

There is a significant increase in funds allocated to SRI investments underway across Europe, as Eurosif (2019) highlighted. The amount invested in Exclusion (funds using negative screening, eliminating companies or sectors from the universe based on ESG

criteria, limiting potential reputation risk for investors), increased 38% from 2013 to 2017, reaching 9.464,485 bi EUR. It represents the most prominent SRI strategy among investors and the most common exclusions are linked to weapons, tobacco, nuclear energy, pornography, gambling, alcohol and animal testing sectors. Leite & Cortez (2015) pointed out that the US SRI funds focus on negative screenings while the European SRI funds use mainly positive and best-in-class screening strategies, selecting the best performance companies taking into consideration the environment and social sustainability in each sector.

According to Novethic (2018), the Green Funds market, funds that allocate resources in renewable energy, energy efficiency, environmental industries (water and waste management) and sustainability, reached 32,2 bi EUR in 2017, a significant increase of 70% since 2016. This strategy focuses on environmental issues, aiming at stimulating energy and ecological transition. It is driven by the idea that the winners of the energy transition in the future will be the innovative players promoting new forms of managing the environment today.

Hamilton et al. (1993) was one of the pioneers in comparing ESG/SRI funds. He analyzed the performance differences between 17 SRI funds and 170 conventional funds domiciled in the US market from 1985-1993. The result indicated that the market did not risk priced SRI investments and investors should not expect any loss by socially responsible investing. Ibikunle et al. (2017) conducted a comparative performance analysis between green, black and conventional funds domiciled in Europe from the period of 1991 to 2014. The study found that green funds had an annualized return of 4,06%, lower than 4,53% for black funds and 5,38 for conventional funds for the full extension of the period. The CAPM estimation also showed an underperformance for both green and black funds against the conventional mutual funds for the whole period. However, when the analysis is divided into two periods, thus from 1991 to 2002 and 2003 to 2014, what happens is a convergence process for their performances, until the last two years of the sample, when green funds have substantially outperformed its black peers and performed in line with the conventional ones.

Climent et al. (2011) examined US green funds' performance against their conventional peers applying a CAPM risk model for the years 1987-2009. The study found ten green funds, seven of them are more than a year old, and for the entire period, green funds earned an average annualized return of 8,45%, lower than the 12,67% for their conventional peers. The same result is attained through the CAPM estimation of

their risk-adjusted performance for the entire period. The result became different for the years 2001- 2009 when green funds obtained risk-adjusted returns not significantly different from the conventional funds. Taivainen (2018), also for the US market, and Fernández et al. (2019), for the German market, reached similar results which confirmed an upward performance trend for green funds over time.

Nevertheless, the previous studies, mentioned above, unveiled mixed and unclear results on the performance of green funds against their conventional peers. One of the reasons could be different market conditions (political, development, historical, etc.) of the countries considered by them. This research contributes to the literature by providing additional evidence on this relationship, in a context of different economic cycles, and by focusing on understudied geography (Europe), with screening strategies that differ from US based funds. Our purpose is to study the past returns for Green Funds over the European Union, in order to shed light on a vital dilemma for investors, as stated by Hamilton et al. (1993), if it is possible to do well while doing good or if it is required to pay a premium if investors are willing to contribute to a sustainable future to the society. Following this assumption, our first hypothesis will be:

H1: The expected risk-adjusted returns of green funds are different than the risk-adjusted returns of conventional funds.

Many studies on SRI funds try to link financial performance to the economic business cycle, comparing funds yield among crisis and non-crisis periods. Fernández et al. (2019) found green funds outperforming their conventional peers during a crisis period, while Leite et al. (2015) and Taivainen (2018) found green funds performing slightly better than conventional ones during crisis periods, though the performance difference is not statistically significant, and Climent et al. (2011) found a higher impact of financial crisis on the performance of green funds than on conventional funds.

These conflicting results provide an opportunity for further investigation and elucidating investors' changes in portfolio decisions. We also believe that the economic business cycle approach is better suited and provides a broader view of market reaction through time, especially with the recent coronavirus crisis, something unprecedented in the history of mankind, leading to our second hypothesis:

H2: Relative expected risk-adjusted returns of green funds associate with the economic business cycle.

3. DATA AND METHODOLOGY

3.1 Data

Thomson Reuters Eikon database is selected to identify funds. First, funds are filtered by selecting ethical in the "strategy", as no option for "green" is available within the application. Filtering ethical funds reduces our universe of options, although including not only sustainable funds, but also all funds applying at least one aspect of ESG screening as a part of their investment strategy (Ibikunle et al., 2017). Additionally, a search for funds is done using some keywords such as "green" and "sustainable".

After the primary identification of green funds, we conducted a manual investigation, reviewing publicly available documents, database of the funds issuers or Morningstar and Financial Times websites. Funds are only kept if there is clear information regarding their sustainability strategy.

Searching for conventional mutual funds followed the same previously described steps. We filtered all mutual funds domiciled in the EU countries without any restrictions regarding their portfolio investment decisions. Since they are much more than their green counterparts, it is easier finding conventional funds matching the criteria, and they easily outnumber their peers.

Our initial sample had 162 green and 982 mutual funds comprised of only those listed as "primary" in Eikon. To ensure the data quality, we have applied some procedures to eliminate potential distortions. Using the Lipper Classification Scheme, we selected only equity funds, removing all bonds, real estate, insurance, pension, and inflation funds. Funds with mixed allocation are equally excluded. Finally, we are keeping only open-ended funds and funds with their investment scope in European equity. Funds without available data or funds with less than six months of data available via Bloomberg are excluded from the final sample.

To avoid survivorship bias, we have included all merged and non-surviving funds closed during our selected period in the analysis. Their exclusion could have led to a significant upward biased empirical result (Taivainen, 2018). We have identified these funds on Eikon and collected the data from Bloomberg, and their return data are kept in the study up to the point they are liquidated or merged.

After the previous screening process, we ended up with a sample of 137 Green Funds and 763 Conventional Funds. Twelve different domiciles are represented in the sustainable funds. However, most of these funds are not only sold in their domicile but are also available for investors all over the European Union. For the conventional funds, our final cut was wider, with twenty-two countries represented, but we have decided to keep only those from countries with at least one green fund so that we can compare the returns between them.

TABLE I

SELECTED FUNDS PER COUNTRY

Domicile	**Green Funds**	**% of Green Funds**	**Conventional Funds**	**% of conventional Funds**
Austria	2	1,5%	16	2,1%
Belgium	3	2,2%	12	1,6%
Denmark	5	3,6%	19	2,5%
Finland	5	3,6%	22	2,9%
France	36	26,3%	185	24,2%
Germany	6	4,4%	64	8,4%
Ireland	9	6,6%	66	8,7%
Luxembourg	56	40,9%	344	45,1%
Netherlands	9	6,6%	8	1,0%
Portugal	1	0,7%	7	0,9%
Spain	1	0,7%	13	1,7%
Sweden	4	2,9%	7	0,9%
Total	**137**	**100%**	**763**	**100%**

The above table displays total funds per country, where green and conventional funds are divided according to the definition presented in chapter 3.1.

Table I exhibits the composition of funds per country. The highest share of green and conventional funds has their domicile in Luxembourg. However, the country does not have the most significant domestic financial market within the region, it is rather well known for charging lower taxes on capital, being a primary choice for asset managers, and investment banks to create funds and then distribute them all over Europe. France is the second most important with a third of all funds, followed by Ireland in third, a country that shares some similarities with Luxembourg.

TABLE II

GREEN FUNDS LAUNCH DATE PER DOMICILE

Country / Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Austria	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
Belgium	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Denmark	3	0	1	0	0	0	0	0	0	0	0	0	1	0	0
Finland	2	0	0	0	0	0	1	0	0	0	1	0	0	0	1
France	15	1	0	0	3	3	1	1	1	0	1	0	3	2	5
Germany	3	1	0	0	0	0	0	0	0	0	0	1	0	1	0
Ireland	1	0	0	0	0	1	1	0	0	1	3	0	2	0	0
Luxembourg	10	2	3	0	1	3	0	1	3	1	1	7	5	6	13
Netherlands	1	1	0	0	0	1	0	0	1	0	2	1	1	1	0
Portugal	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Sweden	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Funds created Total	**43***	**5**	**4**	**1**	**4**	**8**	**3**	**2**	**5**	**2**	**8**	**11**	**12**	**10**	**19**
Cumulative Total	**43***	**48**	**52**	**53**	**57**	**65**	**68**	**70**	**75**	**77**	**85**	**96**	**108**	**118**	**137**

The above table details the creation of new funds per country between 2005 and 2020. Green and conventional funds are divided according to the definition presented in chapter 3.1. *Total of funds created in 2005 or before.

The inception of new funds through the years is displayed on Table II for green and Table III for Conventional Funds. For the first year of the sample, the data corresponds to all funds created in 2005 or before. For 2020 there are no new funds, as to be part of our study, it is required to have at least six months of performance, and our collected data goes until May 2020. The number of new sustainable funds have been thrived since 2014, when the total was 77 and it has reached 137 in 2020, an increment of almost 80% over the period, another clear evidence of its popularity among investors. Conventional funds have had an increment of 40% on their supply since 2014, although this is a significant gain, it is half the figure of their sustainable peers.

TABLE III

CONVENTIONAL FUNDS LAUNCH DATE PER DOMICILE

Country / Year	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Austria	13	0	1	0	0	0	0	0	0	0	0	0	2	0	0
Belgium	7	2	0	0	0	0	0	0	0	0	0	0	0	2	1
Denmark	8	1	0	1	0	4	0	1	0	0	2	0	0	2	0
Finland	12	0	0	0	0	1	2	1	1	0	2	0	1	2	0
France	86	15	8	7	3	5	5	4	6	6	6	10	7	10	7
Germany	38	0	0	0	0	2	2	0	3	1	2	3	5	3	5
Ireland	18	4	2	1	2	2	5	4	1	4	3	4	3	10	3
Luxembourg	112	10	15	17	11	9	12	12	11	20	27	22	27	17	22
Netherlands	4	0	0	0	0	0	0	0	0	1	1	0	1	0	1
Portugal	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Spain	5	1	1	0	0	0	0	0	0	2	3	0	1	0	0
Sweden	3	0	0	0	0	0	0	1	0	0	1	0	1	1	0
Funds created Total	**313***	**33**	**27**	**26**	**16**	**23**	**26**	**23**	**22**	**34**	**47**	**39**	**48**	**47**	**39**
Cumulative Total	**313***	**346**	**373**	**399**	**415**	**438**	**464**	**487**	**509**	**543**	**590**	**629**	**677**	**724**	**763**

The above table details the creation of new funds per country between 2005 and 2020. Green and conventional funds are divided according to the definition presented in chapter 3.1. *Total of funds created in 2005 or before.

More details regarding the two classes of funds can be seen in Table IV. The annualized standard deviation for Green funds is smaller, and their size is larger on average than their conventional peers. The smallest conventional fund is smaller than the smallest green, and the biggest is almost twice the size of its sustainable rival, representing a group more diverse, primarily due to their size over the sample, as they outnumber their peers by six times.

With our sample been identified, the end of the month prices were collected from Bloomberg, and then monthly returns were calculated. The time series consists of 185 months, thus from January 2005 to May 2020, including crisis and non-crisis periods. Each fund is considered from the first period for which monthly performance data is available.

TABLE IV

SUMMARY STATISTICS OF MUTUAL FUNDS

	Total Assets (mi)	Assets on Average (mi)	Smallest Fund (mi)	Biggest Fund (mi)	Standard Deviation	Average Age (Years)
Conventional Funds	€ 171 540,83	€ 224,82	€ 0,279	€ 6 014,59	15,17%	13
Green Funds	€ 35 305,84	€ 257,71	€ 0,303	€ 3 282,44	15,00%	10
Conventional - Green (t-test)		(-0,79)			(2,01)**	(4,012)***

The above table presents overall statistics for our selected funds. Green and conventional funds are divided according to the definition presented in chapter 3.1. *Statistically significant at 10% level. ** Statistically significant at 5% level. ***Statistically significant at 1% level. ****

TABLE V

ANNUAL RETURNS OF MUTUAL FUNDS

Year	Returns		
	Conventional Funds	Green Funds	Conventional - Green (t-test)
2005	20,93%	21,89%	(-0,011)
2006	16,29%	14,69%	(0,061)
2007	1,65%	2,30%	(-0,103)
2008	-50,77%	-51,57%	(-0,014)
2009	26,58%	25,98%	(0,002)
2010	10,58%	9,73%	(0,043)
2011	-11,40%	-12,73%	(0,059)
2012	15,90%	16,57%	(-0,039)
2013	17,82%	17,00%	(-0,016)
2014	4,07%	4,76%	(-0,063)
2015	10,28%	10,53%	(-0,026)
2016	0,59%	0,78%	(0,002)
2017	9,82%	9,30%	(-0,017)
2018	-14,12%	-13,29%	(-0,088)
2019	19,85%	22,56%	(-0,188)
2020*	28,44%	24,98%	(-0,094)
Total Returns	**106,51%**	**103,48%**	**(-0,099)**
Average	**6,66%**	**6,47%**	-

The above table presents the total returns of funds per year. Green and conventional funds are divided according to the definition presented in chapter 3.1. The earnings exhibited are holding period return. *Statistically significant at 10% level. ** Statistically significant at 5% level. ***Statistically significant at 1% level. **** 2020 data goes until May.

Table V reports annual profitability on average for green and conventional funds under analysis in this paper. Yearly returns means are calculated based on monthly returns for each fund from 2005 to 2020 (until May). The profitability follows a similar path among the two classes of funds, and it is clear the upward trend of Green Funds. Over the first half of the sample, conventional funds outperformed their peers in five years. The picture changes over the last half of the sample when green funds outperformed their peers five times.

The identification of recessions and non-recession periods are presented in Table VI. It is adapted from the Centre for Economic Policy Research (CEPR), which uses the €coin, a real-time indicator of the Euro area business cycle. As we can see, there are six periods: three for non-crisis, the years before the Great Recession, the years between the great recession and Euro area crisis, and the years after the "Euro Area debt crisis"; and three periods of crisis, Great Recession, Euro Area and the last one the Coronavirus crisis. Funds returns are also displayed according to the business cycle subdivision.

TABLE VI

BUSINESS CYCLE DATING AND FUNDS RETURNS

Period	Market Conditions	Start date	End Date	Conventional Funds returns	Green Funds returns	Conventional - Green (t-test)
1	Pre-crisis	2005/01	2008/06	21,15%	20,86%	(0,01)
2	Great Recession	2008/07	2009/08	-14,28%	-13,61%	(-0,02)
3	Global Recovery	2009/09	2011/09	0,22%	-1,19%	(0,05)
4	Euro Area crisis	2011/10	2013/08	30,71%	31,20%	(-0,02)
5	Global Recovery	2013/09	2019/12	41,58%	47,30%	(-0,14)
6	Corona Virus crisis	2020/01	2020/05****	-13,77%	-11,17%	(-0,09)

The above table presents the division of our time period through crisis and non-crisis times according to CEPR. Total returns are calculated according to the business cycle division. Green and conventional funds are divided according to the definition presented in chapter 3.1. The earnings exhibited are holding period returns. *Statistically significant at 10% level. ** Statistically significant at 5% level. ***Statistically significant at 1% level. **** 2020 data goes until May.

Although it is too early to fully assess the outcome in the global economy of the Coronavirus outbreak and its extent, it is relevant for us to keep the 2020 data in our study, classifying the entire period as crisis, differently to the CEPR results, as these data usually goes through revision with time (as it happened to the great recession

statistics), and based on the significant turnaround in global markets and the widespread negative results of GDP for the European Union countries in the first two quarters of 2020 (OECD, 2020).

We have chosen the STOXX Europe 600 index as a benchmark to evaluate how risk-adjusted returns from green funds are relatedfact to the business cycle. The index is comprised of large, medium, and small companies across 17 countries from Europe (Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Spain, Sweden, Switzerland and the United Kingdom). Although three of these countries are outside our regional scope (EU), we believe that the widespread number of companies, from all segments, are better suited for this comparison. The return data is also collected from Bloomberg.

The four-factor portfolios (MKT, SMB, HML, MOM), detailed in our methodology session, are downloaded from Kenneth R. French data library. The data also contains the risk-free rate of return used in our regression, comprised of the one-month United States T-bill.

3.2 Methodology

This paper aims to analyze how the risk-adjusted returns of green funds are compared to the risk-adjusted returns of conventional funds between the years 2005 and 2020. Additionally, we also tested how the performance of the green funds correlates to the business cycle, subdividing their performance through expansionary and recessionary times, and testing their returns against benchmarks.

There are two main methods applied in the literature for analyzing and comparing performance of the funds over time. The first method is to make comparisons between funds classes using a matching-pair analysis as done by Leite et al. (2015), Taivainen (2018), Climent et al. (2011), and Fernández et al. (2019). The second method is comparing the means of both classes of funds, as conducted by Ibikunle et al. (2017). We selected the latter approach in this study and by so, we were able to use the full data collected rather than potential synthetic matched pairs. Although grouping similar funds in age and size is possible, the matching process ends up excluding a considerable share of the previously chosen funds, and therefore critical monthly yields are wasted.

Our econometric methodology to evaluate and compare the different funds strategies is based on risk-adjusted returns, as mentioned before. The model selected is based on the single-factor CAPM-based Jensen (1968) which was later extended to a multifactor model (Carhart, 1997), given the criticism received pointing out that one-factor would be insufficient to proxy risk-adjusted expected returns.

The return of a fund in each period is given by $\boldsymbol{r_{i,t}}$, and the calculation is presented below, where $\boldsymbol{p_{i,t}}$ is the price of a fund on time t, and $\boldsymbol{p_{i,t-1}}$ is the price of a fund on time t-1.

(1) $r_{i,t} = (p_{i,t} - p_{i,t-1})/p_{t-1}$

The excess return for a fund ($\boldsymbol{r^e_{i,t}}$) is then calculated, deducting the monthly risk-free return rate ($\boldsymbol{r_{f,t}}$) from the monthly return ($\boldsymbol{r_{i,t}}$), as showed on Equation 2:

(2) $r^e_{i,t} = r_{i,t} - r_{f,t}$

The single-factor CAPM estimation is described in Equation 3, where $\boldsymbol{\alpha}$ is the abnormal risk-adjusted returns, $\boldsymbol{\beta_{MKT}}$ is the market risk exposure of the fund, and $\boldsymbol{r^m_t}$ is the market factor return.

(3) $r_{i,t} - r_{f,t} = \alpha + \beta_{MKT}(r^m_t - r_{f,t}) + \eta_T$

The multifactor Carhart (1997) CAPM expands the single-factor model and takes into account four risk factors which are market exposure of a given fund (MKT), size (SBM), book-to-market (HML) and momentum (MOM) to calculate the outcome for different investment strategies, resulting in the equation below:

(4) $r_{i,t} - r_{f,t} = \alpha + \beta_{MKT}(r^m_t - r_{f,t}) + \beta_{SMB} r^{SMB}_t + \beta_{HML} r^{HML}_t + \beta_{MOM} r^{MOM}_t + \eta_T$

Where $\boldsymbol{\alpha}$ is the multifactor adjusted abnormal return of the fund, $\boldsymbol{\beta_{SMB}}$ is the coefficient measuring the effect of small firms in the fund, $\boldsymbol{r^{SMB}_t}$ is the return spread between the small cap portfolio and the big cap portfolio in time t, $\boldsymbol{\beta_{HML}}$ measures the value premium of the fund, $\boldsymbol{r^{HML}_t}$ is the spread return between a value stock portfolio and a growth stock portfolio at period t, $\boldsymbol{\beta_{MOM}}$ measures the momentum effect of a portfolio in period t and $\boldsymbol{r^{MOM}_t}$ is the past 12 months returns spread between the winner portfolio and the loser portfolio at period t.

4. RESULTS AND DISCUSSION

4.1 Single-factor CAPM regression results

Table VII presents the single-factor CAPM model results using the Kenneth R. French European factor as the market benchmark. We can observe from the results conventional and green funds differing on their performance against the market benchmark. Conventional funds underperformed the market by 2,06%, and green funds outperformed the European benchmark in 2,16%. However, the results are not statistically significant at a 0,05 level.

The betas are 0,65 for both classes of funds when using a narrower market proxy (European market factor for European funds). Therefore, Conventional and Green funds sensitiveness to market risks are similar and both values are less than one, implying lower risks compared to the European broad market factor and no higher risks for a sustainable portfolio.

We can also conclude that the model fits conventional and green funds almost the same, but with R^2_{ADJ} = 0,72 and R^2_{ADJ} = 0,73 respectively, the diversified European factor from the Kenneth R. French better explains our sustainable portfolio than our conventional portfolio, differently from what would be expected, as conventional investments are more diversified and not limited by sector or ESG factors when building a portfolio.

TABLE VII

EMPIRICAL RESULTS USING THE KENNETH R. FRENCH DATA LIBRARY-SOURCED EUROPEAN MARKET FACTOR

Class	α		β_{MKT}		R^2_{ADJ}
Conventional	-2,06	(-0,13)	0,65	(22,03)***	0,72
Green	2,16	(0,14)	0,65	(22,17)***	0,73

The above table reports the results for the single-factor CAPM regression described in equation 3. The proxy market factor was collected from the Kenneth R. French data library. α measures the abnormal risk-adjusted returns against the proxies and it is presented in percentage terms. T-statistics are depicted in parentheses. All parameters described are annualized. *Statistically significant at 10% level. ** Statistically significant at 5% level. ***Statistically significant at 1% level.

TABLE VIII

EMPIRICAL RESULTS USING THE KENNETH R. FRENCH DATA LIBRARY-SOURCED DEVELOPED WORLD MARKET FACTOR

Class	α		β_{MKT}		R^2_{ADJ}
Conventional	-17,64	(-1,20)	0,797	(24,50)***	0,765
Green	-13,41	(-0,92)	0,796	(24,69)***	0,768

The above table reports the results for the single-factor CAPM regression described in Equation 3. The proxy market factor was collected from the Kenneth R. French data library. α measures the abnormal risk-adjusted returns against the proxies and it is presented in percentage terms. T-statistics are depicted in parentheses. All parameters described are annualized. *Statistically significant at 10% level. ** Statistically significant at 5% level. ***Statistically significant at 1% level.

Table VIII exhibits the regression results for green and conventional funds using the Kenneth R. French Developed World factor as the market benchmark and differently from the outcome using the European factor as a proxy, now we have both classes of funds underperforming the market, with -17,64% for conventional funds (not significant) and -13,41% for their sustainable peers, also not statistically insignificant. Despite the general underperformance against the global broad market index, we once again have Green Funds outperforming its conventional peers.

With betas of 0,797 for conventional and 0,796 for green mutual funds, we find a general increment from the European market proxy results, leading to a higher sensitivity to market exposure. Both funds classes are similarly affected by market risks, and sustainable investments pay no premium risk.

Ibikunle et al. (2017) also reached negative alphas for green and conventional funds against the developed world market factor and higher betas than the European factor. The author argues that these high betas are related to selecting an extensive global market benchmark, overstating the sensitivity of the funds returns to the market risk slightly.

Overall, there is an increase in R^2_{ADJ} for the two classes and both numbers are around 0,77, indicating the broad market proxy better capable of explaining our model than the regional European benchmark.

TABLE IX

EMPIRICAL RESULTS USING THE STOXX EUROPE 600

Class	α		β_{MKT}		R^2_{ADJ}
Conventional	-1,01	(-0,20)	0,968	(79,96)***	0,972
Green	3,20	(0,69)	0,967	(86,67)***	0,976

The above table reports the results for the single-factor CAPM regression described in Equation 3. The proxy market factor was collected from Bloomberg. α measures the abnormal risk-adjusted returns against the proxies and it is presented in percentage terms. T-statistics are depicted in parentheses. All parameters are annualized. *Statistically significant at 10% level. ** Statistically significant at 5% level. ***Statistically significant at 1% level.

The results for the regression using Stoxx Europe 600 as proxy are presented in Table IX. The alpha estimated for green funds reveals an outperformance against the market factor, while the conventional funds underperform the index, revealing a significant difference in performance between them. Nevertheless, both figures are not statistically significant at the 0,05 level. These results support our previous regression using Kenneth R. French European factor as a market benchmark, when we had green funds defeating the market and conventional funds exhibiting negative returns against the European index.

Funds betas unveil the two classes of funds presenting similar market risk sensitivity, with conventional mutual funds slightly riskier. The results have statistical significance at 1% level. The R^2_{ADJ} numbers using Stoxx Europe 600 as an index are higher for conventional and green mutual funds (0,972 > 0,72 and 0,976 > 0,73), indicating more efficiency in explaining our model.

We also conducted a regression using an ESG index as the market proxy, the Stoxx Europe 600 ESG-X, based on the Stoxx Europe 600 index, but applying exclusion screenings, avoiding companies involved in controversial weapons, tobacco production and thermal coal sector (extraction, exploration or energy production). The outcomes can be found in Table X.

In terms of abnormal risk-adjusted returns, the outcome is highly favorable for green mutual funds' performance, outperforming the proxy by 11,21%, being statistically significant at the 0,05 level. Conventional funds also outperformed the market by 2,33%, but the results do not have statistical significance.

The beta estimations indicate green funds tending to be less market sensitive than their conventional peers, with 0.96 and 0.97 respectively, both with statistical significance at 1% level. Finally, Table X reports very high adjusted R-squared figures for green and conventional mutual funds portfolios, meaning that the model is very suitable for explaining the risk-adjusted return behavior.

TABLE X

EMPIRICAL RESULTS USING THE STOXX EUROPE 600 ESG-X

Class	α		β_{MKT}		R^2_{ADJ}
Conventional	2,39	(0,41)	0,97	(62,42)***	0,976
Green	11,21	(2,01)**	0,96	(64,42)***	0,977

The above table reports the results for the single-factor CAPM regression described in Equation 3. The proxy market factor was collected from Bloomberg. α measures the abnormal risk-adjusted returns against the proxies and it is presented in percentage terms. T-statistics are depicted in parentheses. All parameters are annualized. The data is available only from 2012 ahead. *Statistically significant at 10% level. ** Statistically significant at 5% level. ***Statistically significant at 1% level.

4.2 Multifactor CAPM regression results

Tables XI and XII summarize the results of estimating the Carhart (1997) multifactor model using Kenneth R. French Developed World and European factors.

TABLE XI

EMPIRICAL RESULTS USING THE KENNETH R. FRENCH DATA LIBRARY-SOURCED EUROPEAN MARKET FACTORS

Class	α		β_{MKT}		β_{SMB}		β_{HML}		β_{MOM}		R^2_{ADJ}
Conventional	1,76	(0,11)	0,65	(18,47)***	0,02	(0,24)	-0,09	(-1,08)	-0,07	(-1,27)	0,72
Green	6,69	(0,41)	0,66	(18,83)***	-0,04	(-0,48)	-0,13	(-1,55)	-0,08	(-1,49)	0,73

The above table reports the results for the Carhart (1997) multifactor model equation, as described in Equation 4 in Chapter 3. Beta factors measure the effects of MKT (Market factor free of risk), SMB (the spread return between a small cap and a large cap portfolio), HML (the spread return between a value stock and a growth stock portfolios), and MOM (a subtraction between the last twelve months winners portfolio and the last 12 months losers portfolio). The proxy market factors were collected from Kenneth R. French data library and they are used to measure the risk-adjusted returns of green and conventional mutual funds. α measures the abnormal risk-adjusted returns against the proxies and it is presented in percentage terms. T-statistics are depicted in parentheses. All parameters described are annualized. *Statistically significant at 10% level. ** Statistically significant at 5% level. ***Statistically significant at 1% level.

Alpha analysis indicates a negative performance for the two classes of funds against the developed world factors and a positive performance for them when confronting European factors. Moreover, we have higher abnormal risk-adjusted yields for green funds against their conventional peers in both cases, the same results as before, using the single-factor CAPM model.

Furthermore, green funds tend to have little more risk exposure to the market portfolio compared to conventional funds in the multifactor model, consistent with the results found by Nofsinger (2013), Taivainen (2018), Ibikunle et al. (2017) and Leite (2015), but contradicting our previous results with the single-factor model. Factor loadings for market betas are statistically significant at 1% level for green and conventional funds.

With negative values in SMB and HML factors, we find European green funds loading more risk exposure to big and value companies, differently from small caps and growth companies found by Ibikunle et al. (2017) and Fernández (2019). This might be the effect of the positive and best-in-class screening strategies used by European funds, as the best companies in each sector are most likely to be the largest, in contrast with the negative screening strategy employed in other markets like the US. Additionally, different strategies also exhibit distinct risk exposure according to the market conditions (Leite, 2015). Green funds also have a negative factor loading on Momentum, the difference in returns between past winners and past losers' portfolio, as also found by Taivainen (2018), implying a negative ability to time the momentum factor and green stocks belonging to the group of loser stocks, probably as a result of their restricted investment universe, not supporting the general view of good following good.

TABLE XII

EMPIRICAL RESULTS USING THE KENNETH R. FRENCH DATA LIBRARY-SOURCED DEVELOPED WORLD MARKET FACTORS

Class	α		β_{MKT}		β_{SMB}		β_{HML}		β_{MOM}		R^2_{ADJ}
Conventional	-15,73	(-1,04)	0,790	(22,30)***	-0,01	(-0,08)	0,08	(0,91)	0,00	(-0,09)	0,76
Green	-12,26	(-0,82)	0,794	(22,57)***	-0,07	(-0,70)	0,03	(0,34)	-0,02	(-0,35)	0,77

The above table reports the results for the Carhart (1997) multifactor model equation, as described in Equation 4 in Chapter 3. Beta factors measure the effects of MKT (Market factor free of risk), SMB (the spread return between a small cap and a large cap portfolios), HML (the spread return between a value stock and a growth stock portfolios), and MOM (a subtraction between the last twelve months winners portfolio and the last 12 months losers portfolio). The proxy market factors were collected from Kenneth R. French data library and they are used to measure the risk-adjusted returns of green and conventional mutual funds. α measures the abnormal risk-adjusted returns against the proxies and it is presented in percentage terms. T-statistics are depicted in parentheses. All parameters described are annualized. *Statistically significant at 10% level. ** Statistically significant at 5% level. ***Statistically significant at 1% level.

In comparison to conventional funds, green funds load a little less on the book-to-market factor (HML), Momentum (MOM), and size (SMB) factors, and a little more on the market risk exposure (MKT). These results are the same for both the Developed World and European factors regressions, as displayed on tables XI and XII.

No consensus is reached among extant literature, although many have considered different timelines and geographical scopes in their studies. The numbers are slightly different from what was reached by Nofsinger (2013), with higher HML and MKT for SRI funds, and higher SMB and MOM for conventional funds; Climent (2011), with higher MKT, SMB, and HML for green and higher MOM for conventional mutual funds; Leite (2015) with higher MKT for SRI and higher SML, HML and MOM for conventional investments; and Ibikunle (2017), with higher MKT, SMB and MOM for green and higher HML for conventional funds.

The results do not report significant differences in R^2_{ADJ} for the multifactor models against single-factor models. The same scenario also happened to Salazar-Fernández (2019). This is unexpected, as many papers predict multifactor regressions better explaining mutual funds returns than a single-factor CAPM model and by so, they should exhibit higher adjusted R-squared.

4.3 Business Cycle Analysis

The alphas estimation for crisis and non-crisis periods are reported in Tables XIII, Panels A and B. The division of the business cycle is done as described in Table VI of Chapter 3.1. During the three crisis periods above mentioned (2009/09 to 2011/09, 2011/10 to 2013/08 and 2020/01 to 2020/05), green funds outperformed their conventional peers (the only statistically significant result is the one for the Euro Area crisis, with 0,10 level).

For the three non-crisis periods (2005/01 to 2008/06, 2009/09 to 2011/09 and 2013/09 to 2019/12), green funds outperformed their peers twice. Conventional funds outperformed their peers only during the period after the Great Recession, when conventional investments had a more robust recovery and presented higher returns against sustainable investments.

Thus, we find Green mutual funds holding up better during crisis periods compared to conventional funds. This is similar to what was found by Nofsinger & Varma (2013) and Salazar-Fernández et al. (2019), and also for Leite et al. (2015) and Taivainen (2018), although without statistically significant results. Climent et al. (2011) found an inverse outcome, with a higher impact of financial crisis on green funds' performance than on conventional funds, the difference is the market studied, as the paper analyzed the US market, where ESG investing is not as mainstream for investors and financial institutions as it is in Europe.

TABLE XIII

EMPIRICAL RESULTS USING THE KENNETH R. FRENCH DATA LIBRARY-SOURCED EUROPEAN MARKET FACTOR PER BUSINESS CYCLE

Panel A							
Period	Market Conditions	Classes	α		β_{MKT}		R^2_{ADJ}
1	Pre-crisis (2005/01 - 2008/06)	Conventional	-51,64	(-1,58)	0,86	(9,47)***	0,68
		Green	-51,11	(-1,53)	0,84	(9,12)***	0,67
2	Great Recession (2008/07 to 2009/08)	Conventional	-21,73	(-0,25)	0,61	(7,48)***	0,81
		Green	-16,06	(-0,19)	0,61	(7,61)***	0,81
3	Global Recovery (2009/09 to 2011/09)	Conventional	-2,92	(-0,07)	0,50	(7,74)***	0,71
		Green	-8,65	(-0,20)	0,51	(7,81)***	0,71
4	Euro Area crisis (2011/10 to 2013/08)	Conventional	51,99	(1,49)	0,53	(7,99)***	0,74
		Green	52,67	(1,68)*	0,54	(9,05)***	0,79
5	Global Recovery (2013/09 to 2019/12)	Conventional	10,20	(0,45)	0,73	(11,82)***	0,65
		Green	18,00	(0,79)	0,72	(11,60)***	0,64
6	Corona Virus crisis (2020/01 to 2020/05)	Conventional	-3,73	(-0,06)	0,94	(13,32)***	0,98
		Green	40,21	(0,68)	0,92	(13,79)***	0,98
Panel B							
Period	Market Conditions	Classes	α		β_{MKT}		R^2_{ADJ}
1	Crisis periods	Conventional	2,8	(0,07)	0,650	(13,84)***	0,82
		Green	11,7	(0,33)	0,649	(14,59)***	0,84
2	Non-crisis periods	Conventional	-3,7	(-0,21)	0,658	(16,12)***	0,65
		Green	-0,9	(-0,05)	0,659	(15,97)***	0,64

Panel A reports the single-factor CAPM regression results described in Equation 3 for each business cycle, and Panel B exhibits the regression results consolidating crisis and non-crisis periods. Business cycle division is done as described in Table VI of Chapter 3.1. The proxy market factor was collected from the Kenneth R. French data library. α measures the abnormal risk-adjusted returns against the proxies and it is presented in percentage terms. T-statistics are depicted in parentheses. All parameters described are annualized. *Statistically significant at 10% level. ** Statistically significant at 5% level. ***Statistically significant at 1% level.

Overall, we can conclude that green funds' performance has consistently improved over time. They have exhibited better risk-adjusted performances against the European market factor for the last three periods (from 2013 to 2020). The explanation could rely on the increased availability of sustainable funds (the number of green funds in the European market went from 75 in 2013 to 137 in 2020, an increment of 88%, as presented on Table 3 on Chapter 3), following the gain in popularity over investors and the enhanced number of companies "going sustainable", expanding the options available for mutual funds managers.

Furthermore, by the results presented in the previous sessions, both of our hypotheses are supported. Regarding the first hypothesis, we have achieved different risk-adjusted returns for green funds compared to their conventional peers for single-factor and multifactor models. Finally, the second hypothesis is also supported. We have green funds' performance fluctuating over the business cycles, with distinct performances according to each crisis and non-crisis subperiods.

4.4 Robustness Analysis

We conduct two supplemental tests to increase the robustness of the results and account for potential distortions in this section. First, we will check if the result achieved for the entire period of our sample will differ from the outcome considering only data between 2015 and 2020, when around 43% of the green and 29% of the conventional funds from our sample were created. Second, we will disregard all data from Luxembourg, the domicile of 40% and 45% of our selected green and conventional funds respectively, to check if its well-known reduced capital gains taxation distorts our total results.

Tables XIV and XV report, respectively, the single-factor and multifactor regressions using the European Market Factor as proxy and limiting our period from January 2015 to May 2020. The abnormal risk-adjusted returns in both cases corroborate our previous results in Chapters 3.1 and 3.2, with green funds outperforming their conventional peers with premiums of 11,82% for the CAPM-based model and 8,82% for the multifactor model, amplifying the magnitude of sustainable investments outperformance seen in our previous results, although lacking statistical significance, and demonstrating the upward tendency for green funds returns over the last years.

Beta market risk exposure increased for the CAPM regressions, thus going from 0,65 for green and conventional funds using the entire period data to 0,83 and 0,81 limiting the period. Similar results are reached for the multifactor model with an increase from 0,65 and 0,66, for conventional and green funds to 0,85 and 0,84, revealing green funds slightly less market sensitive in both models and market factors. Thus, the market risk exposure of our sample has increased altogether with its returns, becoming more volatile and riskier over time. The factor loadings are similar to our previous results, with negative loads on SMB, HML and MOM for both classes of funds.

TABLE XIV

EMPIRICAL RESULTS USING THE KENNETH R. FRENCH DATA LIBRARY-SOURCED EUROPEAN MARKET FACTOR (2015 TO 2020)

Class	α		β_{MKT}		R^2_{ADJ}
Conventional	-5,68	(-0,22)	0,833	(14,07)***	0,75
Green	6,14	(0,24)	0,814	(13,64)***	0,74

The above table reports the single-factor CAPM regression results described in equation 3 for the period compressed between January 2015 until May 2020. The proxy market factor was collected from Kenneth R. French data library. α measures the abnormal risk-adjusted returns against the proxies and it is presented in percentage terms. T-statistics are depicted in parentheses. All parameters described are annualized. *Statistically significant at 10% level. ** Statistically significant at 5% level. ***Statistically significant at 1% level.

TABLE XV

EMPIRICAL RESULTS USING THE KENNETH R. FRENCH DATA LIBRARY-SOURCED EUROPEAN MARKET FACTORS (2015 TO 2020)

Class	α		β_{MKT}		β_{SMB}		β_{HML}		β_{MOM}		R^2_{ADJ}
Conventional	0,74	(0,03)	0,85	(12,37)***	-0,241	(-1,55)	-0,174	(-1,39)	-0,121	(-0,97)	0,76
Green	9,56	(0,35)	0,84	(12,50)***	-0,278	(-1,81)	-0,257	(-2,09)	-0,135	(-1,10)	0,76

The above table reports the Carhart (1997) multifactor model results, as described in Equation 4 in Chapter 3 for the period compressed between January 2015 until May 2020. Beta factors measure the effects of MKT (Market factor free of risk), SMB (the spread return between a small cap and a large cap portfolios), HML (the spread return between a value stock and a growth stock portfolios), and MOM (a subtraction between the last twelve months winners portfolio and the last 12 months losers portfolio). The proxy market factors were collected from Kenneth R. French data library and they are used to measure the risk-adjusted returns of green and conventional mutual funds. α measures the abnormal risk-adjusted returns against the proxies and it is presented in percentage terms. T-statistics are depicted in parentheses. All parameters described are annualized. *Statistically significant at 10% level. ** Statistically significant at 5% level. ***Statistically significant at 1% level.

A subsequent regression analysis eliminating all data obtained from green and conventional funds domiciled in Luxembourg is performed. The results are shown in

Tables XVI and XVII. The alpha analysis suggests a risk-adjusted performance of green and conventional funds aligned with the market factor. No substantial underperformance or outperformance against the market or peers is undertaken, and the results are not statistically significant. This is a slightly different scenario from that reported in Chapters 3.1 and 3.2 when we had green funds clearly outperforming the market and their peers for the single-factor and multifactor regressions.

TABLE XVI

EMPIRICAL RESULTS USING THE KENNETH R. FRENCH DATA LIBRARY-SOURCED EUROPEAN MARKET FACTOR (WITHOUT LUXEMBOURG)

Class	α		β_{MKT}		R^2_{ADJ}
Conventional	0,07	(0,49)	0,007	(23,29)***	0,75
Green	0,12	(0,75)	0,007	(22,60)***	0,73

The above table reports the single-factor CAPM regression results described in equation 3, removing all funds domiciled in Luxembourg. The proxy market factor was collected from Kenneth R. French data library. α measures the abnormal risk-adjusted returns against the proxies and it is presented in percentage terms. T-statistics are depicted in parentheses. All parameters described are annualized. *Statistically significant at 10% level. ** Statistically significant at 5% level. ***Statistically significant at 1% level.

TABLE XVII

EMPIRICAL RESULTS USING THE KENNETH R. FRENCH DATA LIBRARY-SOURCED EUROPEAN MARKET FACTORS (WITHOUT LUXEMBOURG)

Class	α		β_{MKT}		β_{SMB}		β_{HML}		β_{MOM}		R^2_{ADJ}
Conventional	0,11	(0,70)	0,007	(19,48)***	0,000	(0,14)	-0,001	(-0,96)	-0,001	(-1,21)	0,74
Green	0,16	(1,02)	0,007	(19,07)***	-0,001	(-0,67)	-0,001	(-1,29)	-0,001	(-1,42)	0,73

The above table reports the Carhart (1997) multifactor model results, as described in Equation 4 in Chapter 3, removing all funds domiciled in Luxembourg. Beta factors measure the effects of MKT (Market factor free of risk), SMB (the spread return between a small cap and a large cap portfolios), HML (the spread return between a value stock and a growth stock portfolios), and MOM (a subtraction between the last twelve months winners portfolio and the last 12 months losers portfolio). The proxy market factors were collected from Kenneth R. French data library and they are used to measure the risk-adjusted returns of green and conventional mutual funds. α measures the abnormal risk-adjusted returns against the proxies and it is presented in percentage terms. T-statistics are depicted in parentheses. All parameters described are annualized. *Statistically significant at 10% level. ** Statistically significant at 5% level. ***Statistically significant at 1% level.

When analyzing funds' performance data, we find 62% of the fifty conventional funds with the highest holding period returns domiciled in Luxembourg. On the

contrary, we also find exactly another 62% of the fifty lowest holding period returns funds being domiciled in the same region. The figures are less impressive for green funds, but still relevant, with 26% of the fifty highest and 52% of the fifty lowest holding period returns funds domiciled within the country. Therefore, risk-adjusted returns gains and losses are strongly reduced without the country, leading to a minimum premium seen in Tables XVI and XVII for green funds against the market factor and conventional peers.

These findings demonstrate that, besides the over representativity of the country in our sample, Luxembourgish funds high volatility strongly influence the total market risk exposure of our study, and β_{MKT} figures from Tables XVI and XVII support this conclusion, with an overall decreasing from around 0,65 to 0,007 in both models and for both classes of funds comparing with the results taking into consideration the country.

5. CONCLUSION

In this paper, we have analyzed whether European sustainable mutual funds, environmentally friendly investment strategies, outperform or underperform compared to their traditional counterparts between 2005 and 2020. A business cycle analysis is also conducted to check different mutual funds classes' response to crisis and non-crisis periods.

We investigate an essential question for investors - if it is required to pay a premium for going green or if it is possible to do well while doing good. Furthermore, this paper contributes to the literature by being the first to conduct a comparative financial performance analysis for the recent coronavirus outbreak and for highlighting what appears to be a total change in European green investments performance in comparison to traditional unrestricted investments.

Previous academic research has maintained that environmental funds are subjected to higher risks, suffering a negative impact on their performance due to the limitation of stock availability when building a portfolio, and thus they are not as well-diversified as traditional funds. This might be the case for our sample early years, when green funds exhibited lower returns than conventional funds. Nonetheless, this argument does not seem as supported as before. Overall, new studies regarding sustainable finance indicate an improvement in long-term portfolio performance with environmental positioning leading to management improvement, better reputation and greater future value creation.

Our empirical results demonstrate green and conventional funds exhibiting negative abnormal adjusted-returns against the broad developed world market benchmark. The European market benchmark results are the opposite, with environmental mutual funds heading to a positive performance and conventional funds facing a substantial performance enhancement, although still negative.

Remarkably, we find green mutual funds experiencing a substantial big company effect and high exposure to value stocks over the full investigation period, differently from Ibikunle et al. (2017) findings, as growth and small companies were expected to face limited environmental risks and have more propensity for environmental innovation. Among other explanations and besides the differences in the screening strategy employed, environmentally-focused companies stock prices have soared over

recent years due to the increased global demand, triggered by investors' long-term investment approach and sustainability awareness, increasing their market value and becoming larger than ever before. Moreover, large well-known firms have likewise transformed their business toward sustainability, with many others opening branches focused on the renewable energy industry, and they can now pass through green funds strict screenings. We have analyzed the top 10 holdings of the biggest green funds and found many multinational companies, including ASML, Roche Holding, Unilever, Nestle, SAP, Loreal, and Siemens.

When we subdivide the analysis per business cycle, we find green mutual funds providing higher risk-adjusted returns to investors during crisis periods. For the non-crisis periods, we have sustainable funds outperforming their peers during the years before the great recession and after the Euro area sovereign crisis, with traditional funds outperforming only for the years after the great recession. Additionally, we find that green funds have been outperforming their conventional peers since 2011.

Green funds' performance improvement might be driven by a transition from fossil fuel to a more sustainable economy based on renewable energy. The future could not be more promising, with the European Green Deal proposal, aiming to turn Europe into the first climate-neutral continent by 2050, cutting greenhouse gas emissions, boosting energy efficiency, circular economy and fighting climate change and environmental degradation, investing additionally €250 billion annually (1,5% of 2018 GDP) to reach these goals (European Commission, 2019).

The significance of our findings might be limited by the data, chosen geographic region and the specific period of investigation. Furthermore, the classification of ESG and Sustainable investments relies solely on private institutions criteria and a broad intergovernmental effort is required to standardize the definition, create a robust concept, and avoid green washing.

Despite this study's limitations, the results presented in this paper demand attention. The early days of green funds underperformance might be a consequence of a market mispricing, and the increased performance over time is a product of a higher number of institutions providing sustainable options, more sustainable firms in the market, increment on assets under administration, and environmental awareness enhancement over the entire population, including investors.

Finally, society and regulatory requirements could lead to a future where applying ESG screening when building a portfolio is no longer optional for institutions and investors, but mandatory, leading to a financial market no more divided between environmental/ social/ governance funds and traditional funds, defunding entire polluting sectors. This might seem utopic, but avoiding global collapse will require strong actions from all sectors within the economy. Moreover, our future savings are not independent of the real world, and they are directly connected to a healthy, clean planet to live.

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