

Article

# Risk and Performance of European Green and Conventional Funds

Tiago Gonçalves <sup>1,\*</sup>, Diego Pimentel <sup>2</sup> and Cristina Gaio <sup>1</sup>

<sup>1</sup> Advance/CSG, ISEG—Lisbon School of Economics & Management, Universidade de Lisboa, 1200-781 Lisboa, Portugal; cgaio@iseg.ulisboa.pt

<sup>2</sup> ISEG—Lisbon School of Economics & Management, Universidade de Lisboa, 1200-781 Lisboa, Portugal; diegopimentel@msn.com

\* Correspondence: tiago@iseg.ulisboa.pt; Tel.: +351-213-925-800

**Abstract:** This paper analyzes how the risk-adjusted returns of green funds compare to those of conventional funds, between the years 2005 and 2020 for the European Union countries. Additionally, we tested how the performance of green funds correlates to the business cycle, subdividing their performance through expansionary and recessionary times. The findings are summarized as follows: our regression results demonstrated 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 found 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 for green funds indicated a negative load on momentum, book-to-market (HML) and size (SMB) factors, revealing a higher exposure to big and value companies. Subsampling per business cycle exhibited 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; risk; sustainable; investments

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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 re-evaluated 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 therefore, offer steady risk-adjusted returns through time. Following this new trend, investment banks and asset management have increased their supply of green funds over recent years, providing many options for investors screening environmental, social and corporate governance (ESG) aspects on their portfolio allocation decisions.

Although there is empirical evidence of the increased availability of environmental funds, no consensus has been 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, exploring whether 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 studied their behavior over the business cycle. We intended to identify funds' performance over expansion and recession periods, assessing if there was a relevant correlation with the economic cycle.

Our sample comprises 137 green and 763 conventional funds domiciled in European Union countries, considering the period from January 2005 to May 2020. Over one-third of the green funds in our sample had been established since 2016, and almost 60% of them had been established in the last ten years. Eighteen percent of conventional funds had been established since 2016, and had increased by 42% over the past ten years. The econometric models used to evaluate the risk-adjusted returns between funds are the single-factor capital asset pricing model (CAPM) and the multifactor Carhart [1] model. The multifactor model was applied to expand our analysis because it considers four factors to assess the risk-adjusted performance of mutual funds.

The results of fund return means confirmed the upward tendency for green funds. In the first half of our period, conventional funds outperformed their peers, with a 2.9% premium. The results changed considerably over the last eight years of our sample, with green funds paying a 5% premium. For 16 years of our sample, there was an average of 4.21% per year for sustainable investments, contrasted to 4.08% on average for conventional funds. When we subdivided the period into crisis and non-crisis, we found higher returns for sustainable investing, with a premium of 3.76% during crisis times and 4.02% premium for non-crisis subsamples.

From our results, we can draw several conclusions. First, we see a clear difference between green and conventional fund 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 found a distinct outcome using the European market factor, with green funds outperforming the market index, and conventional funds reducing its underperformance. Conventional and green fund returns were similar using the Carhart [1] 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. Finally, the subsampling 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 sections: the second is the literature review; the third exhibits data details and the methodology; the fourth discusses the results obtained; and, finally, the last section presents the conclusions of our research.

## 2. Literature Review

Mutual funds are pooled investment instruments, granting liquidity and economies of scale to investors, providing households with an opportunity to diversify their portfolios across a broad set of markets that they otherwise could not access as retail investors [2]. They are divided into passive and active funds. The first seek to track the index, risk reduction, and charge lower administration fees. The latter 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 only considered 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 Muñoz-Torres et al. [3], the first step for an investor is to select the screening method. It can be negative, excluding investments in some industries, or positive, identifying com-

panies with the best practices on sustainability. Muñoz-Torres et al. [3] states that, although stricter screening reduces investment opportunities, it will be followed by improved selectivity opportunities.

Socially responsible investments (SRIs) have been growing in terms of popularity and have become an essential phenomenon in the financial world. This 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.* [4] (p. 12)

For Nizam et al. [5], investors are concerned if integrating ESG factors in the investment strategy could impact the potential long-term performance of their portfolio. Cappelletti-Blancard and Monjon [6] complements this, 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 relationships. 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 SRIs will not be an act of benevolence. SRIs 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” [7].

Companies are also opting for a socially responsible view in their business [8,9], not just because of market conditions or pressure from shareholders, but also because it is a long-term oriented business approach. Integrating environmental, social and governance (ESG) factors in high management decisions can generate higher and steadier profits in the future for its shareholders. Fernández et al. [10] explained that environmental activities could enhance resource utilization, strengthen business against competition, and improve financial performance of the firm.

Verga Matos et al. [11] extend these conclusions by providing evidence that more sustainable firms will engage better with long term objectives of shareholders and remaining stakeholders, by means of a more stable dividend payout. The authors use data from Stoxx Euro 600 firms.

Dixon-Fowler et al. [12] 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 et al. [13] 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 [2], corporate exposure to environmental risks, governance issues and social practices can effectively disturb long-term firm value, as 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 leak 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 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 is one agency producing ESG scores, gathering information about resource usage, greenhouse emissions, innovation, workforce, human rights, community, product responsibility, management, shareholders, and corporate social responsibility (CSR) 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 et al. [14] analyzed firms in the S&P 500 from 2009 to 2015 to assess whether 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 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 [15] studied the relationship between using Morgan Stanley Capital International (MSCI) 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 et al. [16] compiled 2200 ESG/financial performance research papers for financial markets all over the world, finding clear evidence of a positive ESG/financial performance (FP) relationship, especially for North America and emerging economies. Similar results were found by Ortas et al. [13] 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 [17], a green mutual fund is characterized as one that makes investments based on a sole commitment to environmental principles and engagements, and it comprises companies that demonstrate outstanding environmentally friendly conducts, a low impact on the environment, and are also involved in natural resource protection, energy efficiency activity, clean technology, or renewable energy. A survey conducted by BNP Paribas [18], 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, enhanced brand and reputation, and decreasing investment risk. Nizam et al. [5] 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, such as 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 warming, and mainly comprises companies dedicated to energy efficiency or the production of renewable energy (solar, wind, biomass, nuclear, and biofuels). Using this strategy, previous research [10,17] found that we could expect high exposure to small cap and growth stocks. Climent et al. [19] concluded that, by underweighting some industries, such as oil and gas, and overweighting others, such as utilities, performance funds are biased and the ability to reduce risk by diversification is restricted. Although the stricter screening decreases diversification, it also makes it easier to find better options, because well-managed companies focused on the long-term are those left in the pool, although green funds have a higher concentration in small companies, because green companies are still ramping up operations.

Hong and Kacperczyk [20] studied the empirical evidence of exclusionary SRI using data from sin stocks, both in U.S. markets and European markets. They found that there is a significant ownership effect on institutions more subject to social norms pressure, such as pension funds, but not on the remaining investor types, namely, mutual funds. This ownership effect is argued to promote a stock market neglect-effect which will lead to

lower stock prices (and higher stock returns), lower valuation ratios, and limited stock market access; thus, more debt financing.

There has been a significant increase in funds allocated to SRI investments across Europe, as Eurosif [21] highlighted. The amount invested in exclusion funds, using negative screening and eliminating companies or sectors from the universe based on ESG criteria, limiting potential reputation risk for investors, increased by 38% from 2013 to 2017, reaching EUR 9,464.485 billion. 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.

Many funds across Europe are divesting based on exclusion principles. The Norwegian sovereign fund, for instance, sold its shares of 73 companies due to increased concerns about risks connected to higher carbon emission companies, resource depletion, or corruption and ethical questions, either in their direct operations or in their supply chain [4]. Leite and Cortez [22] pointed out that the U.S. SRI funds focus on negative screenings, while the European SRI funds use mainly positive and best-in-class screening strategies, selecting the best-performing companies taking into consideration the environment and social sustainability in each sector.

According to Novethic [23], the green funds market, funds that allocate resources into renewable energy, energy efficiency, environmental industries (water and waste management) and sustainability, reached EUR 32.2 billion in 2017, a significant 70% increase 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. [7] 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 U.S. market from 1985 to 1993. The result indicated that the market did not risk-price SRI investments, and investors should not expect any loss by socially responsible investing. Ibikunle [17] 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 time 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 was divided into two periods, 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 significantly outperformed their black peers and performed in line with the conventional funds.

Climent et al. [19] examined U.S. green funds' performance against their conventional peers, applying a CAPM methodology for the years 1987–2009. The study found ten green funds, seven of them more than one 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 was 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 [24], also for the U.S. market, and Fernández et al. [10], for the German market, reached similar results, which confirmed an upward performance trend for green funds over time.

Pástor et al. [25] developed an equilibrium model which shows that investors' taste for green assets affect market prices. They argue that ESG investors will accept to pay more for green assets, which will imply a lower cost of capital and, thus, negative CAPM alphas. The model presents an ESG factor, as a scaled return on the ESG portfolio. This factor is part of a two-factor model, together with the market portfolio, with ESG factor loadings (betas) exhibiting the assets' ESG characteristics, where green assets will have a

positive beta, whereas brown assets will show a negative beta. In this setting, assets' CAPM alphas proxy the omitted priced ESG factor, which presents a negative premium derived from green investors' taste. Consequently, if ESG concerns exhibit a positive shock of sufficient strength, green assets outperform brown assets, despite having lower expected returns. In summary, equilibrium asset prices adjust to ESG tastes and concerns by tilting market portfolio towards ESG investors' tastes. ESG firms become more valuable and brown firms less valuable, pushing green assets' negative alphas towards zero.

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 (e.g., Europe).

The other reason that potentially explains previous mixed evidence derives from changes in green asset tastes and concerns, which reflect the positive market shocks from increasing regulation and awareness about sustainability. To provide an answer for the impact of these changes, we study recent evidence, including information from the outbreak of the recent coronavirus disease-2019 pandemic crisis.

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. [7], 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 society. Under Pástor et al. [25], we expect that recent regulation and appetite for green assets will provide green investors with abnormal returns given their exposure to (omitted) priced ESG factor. Following this assumption, our first hypothesis will be:

**Hypothesis 1 (H1).** *The expected risk-adjusted returns of green funds are higher than the risk-adjusted returns of conventional funds.*

Many studies on SRI funds try to link financial performance to the economic business cycle, comparing fund yields among crisis and non-crisis periods. Fernández et al. [10] found green funds outperforming their conventional peers during a crisis period, while Leite and Cortez [22] found green funds performing slightly better than conventional ones during crisis periods, although the performance difference was not statistically significant, and Climent et al. [19] 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 elucidation of 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 regarding the recent coronavirus crisis, something unprecedented in the history of humankind, leading to our second hypothesis:

**Hypothesis 2 (H2).** *Relative expected risk-adjusted returns of green funds associate with the economic business cycle.*

### 3. Data and Methodology

We used the Thomson Reuters Eikon database to identify funds. First, funds were filtered by selecting ethical in the "strategy" field, because no option for "green" was available within the application. Filtering ethical funds reduced our universe of options, although included not only sustainable funds, but all funds applying at least one aspect of ESG screening as a part of their investment strategy [17]. Additionally, a search for funds was conducted using some keywords such as "green" and "sustainable".

After the primary identification of green funds, we conducted a manual investigation, reviewing publicly available documents, databases of the fund issuers, or Morningstar and Financial Times websites. Funds were only kept if there was 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 E.U. countries without any restrictions regarding their portfolio investment decisions. There were many more than their green counterparts; therefore, it was easier finding conventional funds matching the criteria, and they easily outnumbered their peers.

Our initial sample had 162 green and 982 mutual funds, comprising only those listed as “primary” in Eikon. To ensure the data quality, we 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 were equally excluded. Finally, we kept 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 were 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. We have identified these funds on Eikon and collected the data from Bloomberg, and their return data were kept in the study up to the point where they were 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 were represented in the sustainable funds. However, most of these funds were not only sold in their domicile, but were 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 1 exhibits the composition of funds per country. The highest share of green and conventional funds had their domicile in Luxembourg. However, this country did 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 was the second most important with one-third of all funds, followed by Ireland in third, a country that shares some similarities with Luxembourg.

**Table 1.** Funds per country <sup>1</sup>.

Domicile	Green Funds	% Green Funds	Conventional Funds	% 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%

<sup>1</sup> The table displays total funds per country, where green and conventional funds are screened according to the criteria presented in Section 3.

New sustainable funds have thrived since 2014; the total has risen from 77 and 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.

Summary statistics of the two classes of funds can be seen in Table 2. 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 fund, 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, because they outnumber their peers six-fold.

**Table 2.** Summary statistics of funds <sup>1</sup>.

	<b>Total Assets (million EUR)</b>	<b>Average Assets (mil- lion EUR)</b>	<b>Min (million EUR)</b>	<b>Max (million EUR)</b>	<b>Std. Dev.</b>	<b>Average Years</b>
Conventional	171,540.83	224.82	0.279	6014.59	15.17%	13
Green Funds	35,305.84	257.71	0.303	3282.44	15.00%	10
Conventional – Green ( <i>t</i> -test)		(−0.79)			(2.01) **	(4.012) ***

<sup>1</sup> Green and conventional funds are screened according to the criteria presented in Section 3. \* Statistically significant at 10% level. \*\* Statistically significant at 5% level. \*\*\* Statistically significant at 1% level.

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

Table 3 reports annual profitability, on average, for green and conventional funds under analysis in this paper. Yearly return means were calculated based on monthly returns for each fund from 2005 to 2020 (until May). The profitability followed a similar path among the two classes of funds, and it the upward trend of green funds was clear. Over the first half of the sample, conventional funds outperformed their peers in five years. The picture changed over the last half of the sample, when green funds outperformed their peers five-fold.

**Table 3.** Annual returns of funds <sup>1</sup>.

<b>Year</b>	<b>Conventional Funds</b>	<b>Green Funds</b>	<b>Conventional – Green (<i>t</i>-Test)</b>
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%	−

<sup>1</sup> The earnings exhibited are holding period return. The 2020 data ran until May. \* Statistically significant at 10% level. \*\* Statistically significant at 5% level. \*\*\* Statistically significant at 1% level.

The identifications of recession and non-recession periods are presented in Table 4. It was 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. Fund returns are also displayed according to the business cycle subdivision.

**Table 4.** Business cycle and fund returns <sup>1</sup>.

Period	Market Conditions	Start Date	End Date	Conventional Funds Returns	Green Funds Returns	Conventional – Green ( <i>t</i> -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	Coronavirus crisis	2020/01	2020/05 ****	−13.77%	−11.17%	(−0.09)

<sup>1</sup> The table presents the division of our time period through crisis and non-crisis times according to the Centre for Economic Policy Research (CEPR). Total returns are calculated according to the business cycle division. The earnings exhibited are holding period returns. \*\*\*\* 2020 data runs until May. \* Statistically significant at 10% level. \*\* Statistically significant at 5% level. \*\*\* Statistically significant at 1% level.

Although it is too early to fully assess the outcomes on 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 a crisis, differently from the CEPR results, because these data are usually revised with time (as happened with 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.

We have chosen the STOXX Europe 600 index as a benchmark to evaluate how risk-adjusted returns from green funds are related to the business cycle. The index comprises 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 (E.U.), we believe that the widespread number of companies, from all segments, are better suited for this comparison. The return data were also collected from Bloomberg.

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

### Methodology

There are two main methods applied in the literature for analyzing and comparing performance of the funds over time. The first method is to compare between fund classes using a matching-pair analysis [10,19,22]. The second method is comparing the means of both (unmatched) classes of funds, as conducted by Ibikunle [17]. We selected the latter approach in this study, and thus 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. The model selected was single-factor CAPM-based [26], which was later extended to a multifactor model [1], 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  $r_{i,t}$ , and the calculation is presented below, where  $p_{i,t}$  is the price of a fund at time  $t$ , and  $p_{i,t-1}$  is the price of a fund at time  $t - 1$ .

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

The excess return for a fund ( $r_{i,t}^e$ ) is then calculated, deducting the monthly risk-free return rate ( $r_{f,t}$ ) from the monthly return ( $r_{i,t}$ ), as shown in Equation (2):

$$r_{i,t}^e = r_{i,t} - r_{f,t} \quad (2)$$

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

$$r_{i,t} - r_{f,t} = \alpha + \beta_{MKT}(r_t^m - r_{f,t}) + \eta_{i,t} \quad (3)$$

The multifactor Carhart [1] model expands the single-factor model and takes into account four risk factors, which are the 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:

$$r_{i,t} - r_{f,t} = \alpha + \beta_{MKT}(r_t^m - r_{f,t}) + \beta_{SMB}r_t^{SMB} + \beta_{HML}r_t^{HML} + \beta_{MOM}r_t^{MOM} + \eta_{i,t} \quad (3)$$

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

## 4. Results and Discussion

### 4.1. Single-Factor CAPM Regression Results

Table 5 (panel A) presents the single-factor CAPM model results using the Kenneth R. French European factor as the market benchmark. We can observe from the results the conventional and green funds differed on their performance against the market benchmark. Conventional funds underperformed the market by 2.06%, and green funds outperformed the European benchmark by 2.16%. However, the results are not statistically significant at a 0.05 level.

**Table 5.** Regression results: single factor capital asset pricing model (CAPM) <sup>1</sup>.

Class	$\alpha$		$\beta_{MKT}$		$R^2_{ADJ}$
Panel A: European Market Factor					
Conventional	−2.06	(−0.13)	0.65	(22.03) ***	0.72
Green	2.16	(0.14)	0.65	(22.17) ***	0.73
Panel B: Developed World Market Factor					
Conventional	−17.64	(−1.20)	0.797	(24.50) ***	0.765
Green	−13.41	(−0.92)	0.796	(24.69) ***	0.768
Panel C: Stoxx Europe 600 Market Factor					
Conventional	−1.01	(−0.20)	0.968	(79.96) ***	0.972
Green	3.20	(0.69)	0.967	(86.67) ***	0.976
Panel D: Stoxx Europe 600 ESG-X Market Factor					
Conventional	2.39	(0.41)	0.97	(62.42) ***	0.976
Green	11.21	(2.01) **	0.96	(64.42) ***	0.977

<sup>1</sup> The table presents 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 (panel A and B), and from Bloomberg (panel C and D).  $\alpha$  measures the abnormal risk-adjusted returns against the proxies and is presented in percentage terms. T-statistics are in parentheses. All parameters described are annualized. \* Statistically significant at 10% level. \*\* Statistically significant at 5% level. \*\*\* Statistically significant at 1% 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 Kenneth R. French better explains our sustainable portfolio than our conventional portfolio, differently from what would be expected, because conventional investments are more diversified and not limited by sector or ESG factors when building a portfolio.

Table 5 (panel B) 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 both classes of funds underperformed the market, with −17.64% for conventional funds (not significant) and −13.41% for their sustainable peers (also not statistically significant). Despite the general underperformance against the global broad market index, we once again had green funds outperforming their conventional peers.

With betas of 0.797 for conventional and 0.796 for green mutual funds, we found a general increment from the European market proxy results, leading to a higher sensitivity to market exposure. Both fund classes were similarly affected by market risks, and sustainable investments paid no premium risk.

Our results compare to previous literature on European mutual funds. Ibikunle [17] 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.

Overall, there was an increase in  $R^2_{ADJ}$  for the two classes and both numbers were around 0.77, indicating the broad market proxy was more capable of explaining our model than the regional European benchmark.

The results for the regression using Stoxx Europe 600 as a proxy are presented in Table 5 (panel C). The alpha estimated for green funds revealed an outperformance

against the market factor, while the conventional funds underperformed the index, revealing a significant difference in performance between them. Nevertheless, both figures were not statistically significant at the 0.05 level. These results support our previous regression using the 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 unveiled the two classes of funds presenting similar market risk sensitivities, with conventional mutual funds being slightly riskier. The results had statistical significance at the 1% level. The  $R^2_{ADJ}$  numbers, using Stoxx Europe 600 as an index, were 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 analysis 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 results are presented in Table 5 (panel D).

In terms of abnormal risk-adjusted returns, the outcome was 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 did not have statistical significance.

Comparing with extant research, we show that more recent data present green funds outperforming conventional peers, similar to Ibikunle [17]. These results are also in line with Pástor et al. [25], given an external shock related to more regulation and screening of firms' sustainability, green assets will exhibit higher returns, due to stronger loadings on the omitted ESG priced factor, which will reflect positive and larger CAPM alphas.

#### 4.2. Multifactor Regression Results

Table 6 (panels A and B) summarize the results of estimating the Carhart [1] multifactor model using the Kenneth R. French Developed World and European factors.

**Table 6.** Regression results: Carhart multifactor model <sup>1</sup>.

Class	$\alpha$		$\beta_{MKT}$		$\beta_{SMB}$		$\beta_{HML}$		$\beta_{MOM}$		$R^2_{ADJ}$
Panel A: European Market Factor											
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
Panel B: Developed World Market Factor											
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

<sup>1</sup> The table presents the results for the Carhart [1] multifactor model described in Equation (4). Beta factors measure the effects of MKT (Market), 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 (the spread between the last twelve month's winner's and loser's portfolios). The proxy market factor was collected from the Kenneth R. French data library.  $\alpha$  measures the abnormal risk-adjusted returns against the proxies and it is presented in percentage terms. T-statistics are in parentheses. All parameters described are annualized. \* Statistically significant at 10% level. \*\* Statistically significant at 5% level. \*\*\* Statistically significant at 1% level.

Alpha analysis indicated 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 had higher abnormal risk-adjusted yields for green funds against their conventional peers in both cases, the same result as before, using the single-factor CAPM model.

Furthermore, green funds tended to have little more risk exposure to the market portfolio compared to conventional funds in the multifactor model, consistent with previous

results [17,22,24,27], but contradicting our previous results with the single-factor model. Factor loadings for market betas were statistically significant at the 1% level for green and conventional funds.

Relative to the extant literature, our results show negative values in SMB and HML factors. Thus, we found European green funds loading more risk exposure to big and value companies, differently from small caps and growth companies found by previous literature [10,17]. This might be the effect of the positive and best-in-class screening strategies used by European funds, because the best companies in each sector are most likely to be the largest, in contrast with the negative screening strategy employed in other markets such as in the United States. Additionally, different strategies also exhibit distinct risk exposure according to the market conditions [22]. 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 [24], 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.

In comparison to conventional funds, green funds loaded 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 were the same for both the Developed World and European factors regressions, as displayed on Table 6 (panels A and B).

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 and Varma [27] with higher HML and MKT for SRI funds, and higher SMB and MOM for conventional funds; Climent et al. [19] with higher MKT, SMB, and HML for green and higher MOM for conventional mutual funds; Leite and Cortez [22] with higher MKT for SRI and higher SML, HML and MOM for conventional investments; and Ibikunle [17] with higher MKT, SMB and MOM for green and higher HML for conventional funds.

The results did not show significant differences in  $R^2_{Adj}$  for the multifactor models against single-factor models. The same scenario also happened to Fernández et al. [10]. This was unexpected, because many papers predicted multifactor regressions better explaining mutual fund returns than a single-factor CAPM model and, therefore, they should exhibit higher adjusted R-squared.

#### 4.3. Business Cycle Analysis

The alpha estimations for crisis and non-crisis periods are reported in Table 7, Panels A and B. The division of the business cycle is done as described in Table 4. During the three crisis periods (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 was the one for the Euro Area crisis, at 0.10).

**Table 7.** Regression results: CAPM European market factor <sup>1</sup>.

Panel A							
Period	Market Conditions	Classes	$\alpha$		$\beta_{MKT}$		$R^2_{Adj}$
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		Conventional	10.20	(0.45)	0.73	(11.82) ***	0.65

6	Global Recovery (2013/09 to 2019/12)	Green	18.00	(0.79)	0.72	(11.60) ***	0.64
	Coronavirus 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	$\alpha$		$\beta_{MKT}$		$R^2_{ADJ}$
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

<sup>1</sup> 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 performed as described in Table 4. The proxy market factor was collected from the Kenneth R. French data library.  $\alpha$  measures the abnormal risk-adjusted returns against the market 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.

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 found green mutual funds holding up better during crisis periods compared to conventional funds. This is similar to previous literature [10,22,24,27], although without statistically significant results. Climent et al. [19] found an inverse outcome, with a higher impact of the financial crisis on green funds' performance than on conventional funds. The difference is the market studied, because the paper analyzed the U.S. market, where ESG investing is not as mainstream for investors and financial institutions as it is in Europe.

Overall, we can conclude that green funds' performance has 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%), following the gain in popularity over investors and the enhanced number of companies "going sustainable", expanding the options available for mutual funds managers.

In non-tabulated results, we also tested for differences in the risk-adjusted performance of green and conventional funds, using the Carhart [1] four factors model. The results remained significantly similar in terms of performance and risk factor loadings during non-crisis macroeconomics. During crises, our results show that green fund load risks tilt towards smaller sized and growth stocks.

#### 4.4. Robustness Analysis

We conducted supplemental tests to increase the robustness of our results and account for potential distortions. We checked if the results achieved for the entire period of our sample differed from those only considering data between 2015 and 2020, when around 43% of the green and 29% of the conventional funds from our sample were created.

In non-tabulated results, we tested 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 corroborated our previous results, with green funds outperforming their conventional peers with premia 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 fund 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 were 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, respectively, revealing green funds to be 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 were similar to our previous results, with negative loads on SMB, HML and MOM for both classes of funds.

## 5. Conclusions

In this paper, we have analyzed whether European sustainable mutual funds outperformed or underperformed compared to their traditional counterparts between 2005 and 2020. A business cycle analysis was also conducted to check different mutual fund classes' responses to crisis and non-crisis periods. Furthermore, this paper contributes to the literature by being the first to conduct a comparative financial performance analysis which includes the recent coronavirus outbreak, and for highlighting what appears to be a total change in European green investment 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, in line with Hong and Kacperczyk [20] analysis of sin stocks. This might be the case for our sample's early years, when green funds exhibited lower returns than conventional funds. Nonetheless, this argument does not seem as well-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 leading to a positive performance, and conventional funds facing a substantial performance enhancement, although still negative.

Remarkably, we found green mutual funds experiencing a substantial big company effect and high exposure to value stocks over the full investigation period, differently from Ibikunle [17]'s findings, because 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. This setting, in turn, reconciles our results with Pástor et al. [25]'s model: if ESG concerns exhibit a positive shock of sufficient strength, green assets outperform brown assets, despite having lower expected returns. Equilibrium asset prices adjust to ESG tastes and concerns by tilting market portfolio towards ESG investors taste. ESG firms become more valuable and brown firms less valuable, pushing green assets' negative alphas towards zero, in the long term. In the short term, green funds will benefit from higher exposure (betas) to ESG factor, thus outperforming non or lower ESG characteristics' funds.

When we subdivided the analysis per business cycle, we found 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 them only for the years after the great recession. Additionally, we found that green funds have been outperforming their conventional peers since 2011.

Green funds' performance improvements 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, incorporating a circular economy, and fighting climate change and environmental degradation, investing additionally EUR 250 billion annually (1.5% of 2018 GDP) to reach these goals [28].

The significance of our findings might be limited by the data, chosen geographic region and the specific period of investigation. Furthermore, the classifications of ESG and sustainable investments rely 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 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, however 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 in which to live.

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