Universidade do Minho
Escola de Economia e Gestão

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The Performance of Green and Black European mutual funds investing in the Global Market

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Statement of integrity

I hereby declare having conducted this academic work with integrity. I confirm that I have not used plagiarism or any form of undue use of information or falsification of results along the process leading to its elaboration.

I further declare that I have fully acknowledged the Code of Ethical Conduct of the University of Minho.

Resumo

Esta dissertação analisa o desempenho de 21 fundos de investimento verdes e 28 fundos de investimento pretos, domiciliados em seis países europeus, ao nível agregado e individual. O período de amostragem considerado é de dezembro de 2003 a novembro de 2019. A avaliação de desempenho dos fundos é feita recorrendo a modelos multifatoriais não condicionais e condicionais. Adicionalmente, é também, realizada uma avaliação do desempenho dos fundos em diferentes condições de mercado, nomeadamente, em períodos de recessão e expansão. Em geral, a evidência empírica exibe um desempenho neutro entre os fundos de investimento verdes e pretos, o que significa que os investidores não podem esperar rendibilidades superiores ou inferiores ao investirem neste tipo de fundos. Considerando os fundos verdes, o poder explicativo dos modelos é mais elevando quando é usado um índice convencional. Por contraste, para os fundos pretos este coeficiente é mais elevado quando é usado um índice preto. Relativamente, à análise em diferentes condições de mercado, os fundos de investimento verdes, mostram um desempenho inferior em períodos de expansão, enquanto, em períodos de recessão, o desempenho destes fundos não diverge significativamente. Em relação aos fundos de investimentos pretos, o desempenho é neutro em períodos de expansão, e também não diverge significativamente em períodos de recessão. Considerando as diferenças entre carteiras, os resultados não são significativos, indicando um desempenho equivalente entre os fundos verdes e pretos. Adicionalmente, os resultados apoiam o uso de modelos condicionais, provando ser melhores a explicar as rendibilidades das carteiras.

Palavras-chave: Avaliação de desempenho; Fundos de investimento verdes; fundos de investimento pretos; Indústria combustíveis fósseis; Investimento socialmente responsável.

Abstract

This dissertation analyses the performance of 21 green mutual funds and 28 black mutual funds, domiciled in six European countries, at the aggregate and individual level. The sample period is from December 2003 to November 2019. The performance evaluation of funds is produced using unconditional and conditional multifactor models. Additionally, we also develop a performance evaluation of funds in different market states, namely, in recession and expansion periods. In general, empirical evidence exhibits no statistically significant differences between the performance of green and black mutual funds, indicating that investors will not obtain higher or lower returns investing in these types of funds. Considering the green mutual funds, the explanatory power of the models is higher when using a conventional index. By contrast, for black funds, this coefficient is higher when applying a "black" index. In relation to the analysis in different market conditions, green funds show an inferior performance in expansion periods, while in recessions, the performance of these funds does not diverge significantly. With respect to black funds, the performance is neutral during expansions, and also does not diverge significantly in recessions periods. Concerning the portfolios' difference, the results are not significant, suggesting a similar performance between green and black funds. Additionally, the results also support the use of conditional models, proving to be better to explain the portfolio's returns.

Keywords: Black mutual funds; Fossil fuel industry; Green mutual funds; Performance evaluation; Socially responsible investment.

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1. Introduction

During the past decades, environmental concerns have been playing an extremely important role in society. There is a general idea that climate change is occurring, and the main causes are associated with the human hand. Problems related to climate change, global warming, the destruction of ecosystems, natural resource scarcity, among others, are getting worst and may severely affect the economic conditions of the entire world. This may occur, due to the high costs of programs used to adapt consumption behaviors and production patterns to the new environment and also due to the implementation of clean energy sources, which are also very expensive (Eyraud et al., 2013).

As a consequence, these concerns, led to the implementation of laws and actions, mainly in Europe and in the U.S. For example, the United Nations have developed reports and conferences about the environment. The first conference was in 1972, in Stockholm, where the United Nations Environmental Programme (UNEP) was established, defining the principles and recommendations that man should follow, to protect the environment and consequently, the well-being of people. In May 1992, took place the United Nations Framework Convention on Climate Change (UNFCCC) with the purpose to stabilize greenhouse gas emissions to the atmosphere. In the same year, the United Nations Conference on Environment and Development, held in Rio de Janeiro, defined a global plan to promote sustainable development (Agenda 21). The implementation of the Kyoto Protocol, an international agreement from 1997, is seen as the operationalization of UNFCCC, whose parties established their emission targets to reduce their greenhouse gas emissions. Moreover, the Copenhagen Accord in 2009, established a target of 565 gigatons carbon ($GtCO_2$) emissions, to keep global warming below 2ºC.

Jointly to these environmental actions, there are also some campaigns supporting the fossil fuel divestment. The first fossil fuel divestment campaign started in the US, in the Swarthmore College. On July 2012, Bill McKibben appealed to a divestment campaign with the purpose to force governments and fossil fuel firms to leave fossil fuels, applying to the use of less carbon-intensive forms of energy supply and

pressuring the governments to apply a carbon tax or/ and to forbid future drilling. Additionally, some fossil fuel companies have already been establishing measures to protect the environment. For example, in 2000, British Petroleum (BP), a fossil fuel company, was the first to recognise climate change as a global problem and also supported the Kyoto Protocol. Besides, BP also modified their brand image to Beyond Petroleum, changing for a green and yellow sunflower (Ansar et al., 2013).

Furthermore, the global development of renewable energy sources has been promoted across countries. The exceptional performance of renewable energy stocks has been seen as consequence of investors optimistic feelings about this type of investment. In Europe, the promotion of clean energies is seen as a mean to warn the European population about sustainable energy supply and also as a way to change from nuclear energy to alternative energy sources in the future (Bohl et al., 2015). Additionally, renewable energy growth is explained by CO_2 emissions target and Kyoto Protocol commitments, showing that a country's commitment with reducing greenhouse gas emissions and with the Kyoto protocol is seen as a progress in renewable energy growth.

Fortunately, green investment has been growing and it is now proportional to the fossil fuel investment. During the first decade of the 21th century, green investment increased from $7billion to $154 billion. The main drivers of this huge increase are the global economic growth, low interest rates, high fossil fuel prices, technology developments and innovation, governmental support, the increasing pressure of people for a better environment and also depend on the availability of natural resources (Eyraud et al., 2013).

Also fortunately, investors are getting conscious about the needs of the environment. In fact, there is an increasingly popular concern about the negative impact of investors decisions on the environment, which led to a higher inclusion of investors green values in their investment decisions. All this stimulates the increase of Socially Responsible Investment (SRI) around the world (Silva & Cortez, 2016).

The main purpose of this dissertation is to analyse the performance of green and black mutual funds. The analysis is done at the aggregate and individual fund level, to

provide a more complete study about funds' performance. The objective is to assess the performance of these two types of mutual funds using conventional and sector *benchmarks*, in six European countries. Financial literature about green mutual funds has been receiving special attention in recent years, although there are still a limited number of academic studies about this topic. Considering black mutual funds, to the best of my knowledge, there is only one empirical study about these funds' class. The remaining financial literature about "black" energy concerns the fossil fuel market stocks. The limited number of empirical studies is justified by the very recent creation of green and black classes of mutual funds. In this context, the main motivation of this dissertation is related to the very restricted number of studies concerning these topics. The idea is, in fact, to verify if the results are consistent with previous findings and, therefore, contribute to the literature on this particular topic.

Considering the methodology, the four-factor unconditional model of Carhart (1997) and the Fama and French (2015) five-factor model are applied. In addition, the conditional performance evaluation model of Christopherson et al. (1998) is was also used, allowing for time-varying risk and return. By incorporating variables that reflect the state of the economy, conditional models tend to me more robust in the assessment of fund performance. Additionally, and as an alternative way to control for recession and expansion periods, a dummy variable, was introduced in the two alternative unconditional models applied.

The remaining of this dissertation is organised in five chapters. The second chapter reviews and discusses the literature on socially responsible investment, the performance of green funds, the performance of black funds and also the relationship between clean energy stock prices and the oil stock prices. The third chapter presents the unconditional and conditional performance evaluation models used, followed by the description of the sample and data sources. Chapter five, reports and discusses the main empirical results and finally, in sixth chapter the main conclusions are summarised.

2. Literature Review

This chapter discusses previous literature about socially responsible investment, green investment, black investment, and performance evaluation in different market states. As green funds are considered a subset of socially responsible funds, we start this literature review discussing some papers concerning SR funds' performance, mainly in the European market. Regarding green investments, first the relationship between environmental practices and financial performance is analysed, giving examples of studies with neutral, positive, and negative performances. Although financial literature on green mutual funds' performance is scarce, some examples of studies on this particular topic are presented on the context of European and the US markets. For black investment previous literature is also very rare. First, we analyse, to the best of our knowledge, the empirical evidence of the first study assessing black mutual funds' performance. Additionally, we also report some conclusions about the relationship between oil prices and clean energy. Finally, some empirical results about socially responsible and green funds' performance in different market conditions are reviewed and discussed.

2.1 Socially Responsible Investment (SRI)

The concern about Socially Responsible Investment has been growing over the years. The definition of what is "sustainability" or even "sustainability-related" has been created some controversy over the past years. However, the European Sustainable Investment Forum (Eurosif) report, launched in 2016 a definition about SRI, saying that *"Sustainable and responsible investment ("SRI") is a long-term oriented investment approach which integrates ESG factors in the 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 behaviour of companies."*.

One of the first studies about socially responsible investment was developed by Moskowitz (1972). When comparing the performance of socially responsible funds with

conventional funds, previous studies have shown similar performance between these two types of funds (Cortez et al., 2009; Cortez et al., 2012; Leite & Cortez, 2014; Leite et al., 2018). However, other studies report different conclusions. For example, Gil-Bazo et al. (2010), performed an analysis between 1997 to 2005, concluding that, in certain circumstances, socially responsible funds outperform their conventional peers. For example, the results indicate that SRI funds show a better performance before and after-fees, and SRI funds, managed by specialist SRI investment managers, also outperform their conventional matches. On the opposite side, Renneboog et al. (2008) developed a study including socially responsible funds (SRI) from three different regions (Europe, North-America, and the Asia-Pacific). Empirical results indicate that in most countries the SRI funds do not underperform their conventional matches, but for French, Irish, Swedish, and Japanese socially responsible funds the evidence supports an underperformance.

Previous literature has been analysing the performance of socially responsible funds, revealing some different conclusions that might be a result of geographical differences (Cortez et al., 2009). A very common conclusion is that SRI funds are more exposed to small capitalization stocks (Bauer et al., 2005; and Cortez et al., 2012). Moreover, Bauer et al. (2005) also reported that UK and US socially responsible funds are more exposed to growth stocks. However, other studies indicated a higher exposure toward value stocks. For example, Bauer et al. (2006) observed that Australian ethical funds are more oriented to value stocks.

The majority of the first studies related to the performance of socially responsible funds are focused on the US market, but along the years this analysis has been extended to European countries.

In the European market, Cortez et al. (2009) found, in general, an analogous performance between socially responsible funds and conventional funds. The authors used a sample composed of 88 socially responsible funds from Austria, Belgium, France, Germany, the Netherlands, and the UK for the period from August 1997 to February 2007. Besides, the findings indicate that socially responsible funds are more exposed to conventional *benchmarks* than to socially responsible ones because the betas are higher when computed with the former. Additionally, the adjusted coefficient of determination

is higher when applying a conventional *benchmark*, indicating that this index is more useful to explain the performance of socially responsible funds.

Later, Leite and Cortez (2014) analysed the performance and investment styles of 54 European SRI funds investing at a Global and European level. The performance of funds is measured using multi-factor models during the period from January 2000 to December 2008 and it was also done a comparison between the performance of funds using "best-in-class" screens with funds using "positive" or "negative" screens. In general, socially responsible funds show a neutral performance when compared to their matched portfolios. The authors associate this neutral performance to the use of "best-in-class" screening, which is the most common screen in Continental Europe. Besides, the results indicate that European socially responsible funds are less exposed to small caps when compared with their conventional peers. The findings also show that the adjusted R^2 of the models is higher when conventional indices are used than when socially responsible *benchmarks* are used, in line with the results of Cortez et al. (2009, 2012).

Leite et al. (2018) performed an analysis of socially responsible funds in Sweden, over a period of time from November 2002 to October 2012. This study has three main objectives: compare the performance of socially responsible funds with conventional funds; compare selectivity abilities and timing of socially responsible and conventional funds and examine the changes in performance according to different market conditions. The authors applied three tests of significance to understand which was the best *benchmark* to use, concluding that the conventional indices were the most appropriate. In the case of European funds investing domestically, using multifactor models, the authors concluded that there are no statistical differences between the performance of socially responsible and conventional funds. In the case of funds investing globally, there is evidence of an underperformance. However, only three socially responsible funds and three conventional funds underperform the benchmark. Additionally, conventional funds are more exposed to small-cap stocks than socially responsible funds, which contrasts with previous findings, like Cortez et al. (2012).

Moreover, some studies analyse both American and European markets. For example, Cortez et al. (2012) made a study, from August 1996 to August 2008, using a

sample of 39 European and 7 US socially responsible funds. The results obtained from the single-index models, using both a conventional (MSCI AC World Index) and a socially responsible index (FTSE4Good Global) are very similar, indicating that in the most of European markets socially responsible funds show similar performance to conventional funds. However, for the US and Austria, the findings demonstrate an underperformance. Furthermore, socially responsible funds are more exposed to conventional indices than to socially responsible indices, which is consistent with Cortez et al. (2009). The authors also concluded that there is an increase in the explanatory power of the model when conditional models of Christopherson et al. (1998) are used, being consistent with Cortez et al. (2009). Relatively to the investment style, the results show that socially responsible funds are more exposed to growth stocks and small-cap stocks. Additionally, the authors made an important observation, saying that the underperformance of some SRI funds may be seen as a result of their constrained investment region, meaning that the diversification of the investment universe may help SRI funds to achieve better performance.

2.2 Green investment

Green mutual funds are considered a subset of socially responsible mutual funds. Finance literature about green mutual funds has been receiving special attention in recent years, although there are still a limited number of academic studies about this specific topic. According to Ibikunle and Steffen (2017), a green mutual fund is a fund dedicated to invest only in environmental principles and commitments. These funds give investors a way to support firms that have good environmental perspectives, for example, companies with cleaner production methods. Green investors must give special attention to the impact that their investment decisions have on the natural environment and must choose their investments following environmental criteria (Silva & Cortez, 2016).

Climent & Soriano (2011) argued that the increased concern with environmental issues from firms, investors and governments might create profitable opportunities for businesses chasing sustainable purposes.

2.2.1 Relationship between environmental practices and corporate financial performance

Previous literature about the impact of green investment is typically associated to a firm perspective, discussing if the presence of environmentally friendly actions benefits or punishes corporate financial performance. The results in these studies are inconclusive, revealing the lack of consensus in this subject. Following the neoclassical view, inspired in Friedman (1970), the adoption of such practices could lead to a decrease in profitability, a result of high production costs linked to environmental innovation (Dunn & Burton, 2006). However, the stakeholder theory, based in Freeman (1984), states that productivity and shareholders' value will increase if the company is concerned with the welfare of all the ones who have a stake in the organization. Following this theory, the implementation of environmental actions can improve corporate financial performance in long term, by allowing firms to accomplish competitive advantages and to reduce production costs by reducing environmental risks (Manrique & Martí-Ballester, 2017). In this line, some past studies support a positive impact of environmental practices in corporate financial performance, others a negative impact and others indicate a neutral relationship.

On the positive side, Montabon et al. (2007) concluded that there is a positive relationship between environmental management practices (EMPs) and firms' performance. This study showed, for example, that recycling can lead to an improvement in sales growth and that firms, which build products using recovered components might reduce their structure costs. Besides, there is a series of reasons that led us to believe that firms with environmentally friendly strategies may have higher revenues and lower costs. For example, Ambec and Lanoie (2008), made a study showing that a firm's revenues could be increased due to three important factors, which are: "*better access to certain markets, differentiating products and selling pollution-control technology*". Besides, lower costs can also be achieved through "*risk management and relations with external stakeholders, cost of material, energy, and services, cost of capital and cost of labor*". The authors also explained that not all the

firms will benefit from a green investment, giving the example of a energy firm located in the US and a farm.

More recently, Manrique and Martí-Ballester (2017) tried to answer the question *"Where does it pay to be green?"*. The authors, using a sample of 2982 large firms, for the period from 2008 to 2015, performed a study with two main objectives. Firstly, they examined the effect of corporate environmental performance on large firms' financial performance and secondly, they analyzed the effect of environmental practices on large firms' financial performance in developed and developing countries. The main results demonstrate that the advantages of adopting environmental activities exceed the costs created from employing them. Besides, the findings indicate that firms with better corporate environmental performance also have better corporate financial performance, in periods of crisis. However, this effect is stronger for companies in developing countries, which can be explained by the implementation phase, among other reasons.

However, there is the opposite view, which advocates that corporate environmental responsible actions have a negative impact on financial performance, saying that those green practices lead to extra costs. Hong et al. (2012) analysed how constrained and unconstrained firms invest in goodness, evaluating companies according to community and employee relations, diversity of the workforce, environmental protection, product quality, and corporate governance. The main findings show that more constrained firms have higher corporate goodness during the technology bubble of the late 1990's (1996-2000). Furthermore, the authors also proved empirically that less constrained firms spend more on goodness, concluding that "*goodness is costly*" and "*a complement to profits*". Another study supporting this view was made by Lioui and Sharma (2012), indicating that environmental corporate social responsibility (ECRS) involves costs and has a negative impact on companies' return-on-assets (ROA). Additionally, it was also proved that there is a negative relationship between environmental concerns or strengths and corporate financial performance when measured by Tobin's Q.

In the neutral view, Puopolo et al. (2015) performed a study answering the question "*does the market reward or penalize the players that carry out responsible*

management policies toward environment?". This study analyses 500 US firms with environmental commitments from 2009 to mid-2014, applying the CAPM and the Fama and French three-factor model. The findings suggest that there is no bonus or penalization for those who pursuit environmental practices. The authors state two main reasons for this result, saying that the current "green wave" makes the effects harder to measure and besides, larger companies could have a higher influence on the market than smaller firms. Regressing both the CAPM the Fama and French models, the alpha coefficient of firms is not statistically significant, meaning that the "*green-factor*" does not influence abnormal returns.

Beyond these views, some authors support a curvilinear relationship between environmental and financial performance. Ramanathan (2018) applied a survey to manufacturing companies in the UK, having a final sample of 134 questionnaires. The evaluation of environmental performance was made using both environmental certifications and self-evaluation over the past five years. For firm performance the method was identical, using self-evaluation of sales growth and progress in market share. The author made a regression analysis to measure the impact of moderated environmental performance on the relationship between environmental and firm performance. The findings indicate that there is a powerful moderate impact of environmental performance on the relationship between environmental and firm performance. Firms with a better environmental performance show a higher moderate impact of environmental performance in this relationship. The results suggest the existence of a curvilinear relationship between environmental and financial performance.

Moreover, Pekovic et al. (2018) also reported evidence of a curvilinear relationship. The analysis is made based on a sample of 29719 observations during the period from 2003 to 2007. This sample was obtained by two French surveys, the ANTIPOL and the Annual Firm Survey (EAE). The results point out that there is a curvilinear relationship (almost a U-inverted curve) between environmental actions and financial performance, meaning that beyond the optimal level of environmental investment, more environmental investment is negative for financial performance. A

curious finding was that 20% of the surveyed firms use 16.5% or more of their sales to invest in environmental issues.

To understand this link between corporate environmental performance and financial performance some studies were developed based on a meta-analysis. For example, Dixon-Fowler et al. (2013) developed a study with the objective to answer the question *"When does it pay to be green?".* To do so, they based their analysis in the identification of moderators of the corporate environmental performance and corporate financial performance relationship like types of environmental performance, companies' characteristics, and methodological concerns. To identify their sample, they used EBSCO and ProQuest databases and manual searches of journals, getting 71 samples. The findings show that proactive firms do not have additional benefits compared to reactive firms, meaning that companies have similar advantages for pursuing either one or other approaches. In relation to firms' characteristics, all firms benefit from this relationship. Although, the results indicate that small firms have a higher impact on the relationship between corporate and financial performance than large firms. Additionally, public and private firms appear to have similar advantages and US firms seem to benefit more than other international companies. In terms of methodological issues, the authors developed an analysis using indicators, like profitability, market-based, firm growth, and cost-efficiency, concluding that corporate environmental performance has a higher influence in market-based measures. Moreover, this means that the choice of the type of corporate environmental performance measure does not make a difference in the final results. Besides, it was proved that self-report data has a similar influence in results as archival data. In general, the meta-analytic outcomes reveal a positive relationship between corporate financial performance and corporate environmental performance. The authors concluded that relevant conditions moderate this relationship.

2.2.2 Performance of green mutual funds

The first study about green mutual funds was implemented by White (1995), analysing the performance of green mutual funds in the U.S and German markets. The main results showed that the U.S green funds underperform their conventional peers.

In the US market, Climent and Soriano (2011), performed a study comparing U.S. green mutual funds with SRI and conventional funds' matched samples, during the full period from 1987 and 2009. First, the authors estimated a one-factor model, using a value-weight portfolio from the CRSP database and the *S&P 500 Index* as a market proxy, concluding that green funds underperform conventional funds. However, when analysing a more recent period, from 2001 to 2009, using the *FTSE KLD Global Climate 100 Index* as the market *benchmark*, the results show no statistically differences between green and conventional mutual funds, suggesting that this difference in the results can be explained by inappropriate use of the market *benchmark*. When the market proxy is the *KLD400* (SRI index), the performance is negative and not statistically significant. With the four-factor model of Carhart (1997), analysing the full period, the results still demonstrate the green funds' underperformance and still show a neutral performance from green funds in a more recent period (2001-2009). Moreover, the authors also observed a higher explanatory power for the four-factor model, which corroborates the idea that multi-factor models compared to the one-factor model of CAPM is better in explaining mutual fund returns. Besides, the results also indicate that green funds are heavily exposed to small capitalization and growth stocks.

Chang et al. (2012), made an analysis of operating characteristics and risk and performance measures of US green mutual funds using a sample of 131 green funds, identified by US SIF, during a maximum period of 15 years. The authors concluded that green funds gain from lower turnover ratios and lower taxes but typically pay higher expenses, showing higher expense ratios in 12 of the 19 categories. Relatively to performance measures, the main results show that green funds underperform, which is consistent with Climent and Soriano (2011). The authors suggested that this underperformance can be explained, among other reasons, by the massive costs that firms are incurring to create their environmentally friendly products, which will only develop future profits. Besides, this article suggests that green funds limitations do not involve more risk, meaning that green mutual funds risk seems to be similar to conventional funds.

Concerning the European market, Ibikunle and Steffen (2017) analysed the performance of green mutual funds and their black and conventional matches, from

January 1991 to June 2014. This article presents results using the one-factor model of CAPM and the four-factor model of Carhart (1997). Considering the first model, the authors compared the performance of the three classes of funds with the market, using the *Kenneth R. French* global factor, the *FTSE Global Small Cap Index,* the *Stoxx Europe 600 Index* and the *S&P Global Alternative Energy Index* as market *benchmarks*, concluding that green funds underperform the market. Considering the four-factor model, the authors used the global and the European factors from *Kenneth R. French data library*, verifying the same underperformance. Analysing the performance of green funds and their conventional peers, Ibikunle and Steffen (2017) found that green mutual funds underperform their conventional peers, which is expected because black and green funds suffer from investment restrictions. The authors concluded that these constraints limit the green funds' diversification and may negatively influence their financial performance. However, examining the last five years, green mutual funds show similar performance to conventional funds.

Other studies focus on both European and US markets. For example, Ito et al. (2013) made a comparative analysis between environmentally friendly and SRI funds in the U.S, EU, and Japan, considering a long period from 2000 and 2009 and a short period from 2006 to 2009. The authors used a dynamic mean-variance approach, believing that this new approach is better than the CAPM-based analysis. This method involves the use of two different models, the *Dual model*, which combines return and risk orientation and the second model, which only considers the return orientation. However, to make a comparison between these two methods, the authors also examined the performance of SRI and environmentally friendly funds using the CAPM approach. The main conclusion of the study is that using the dynamic mean-variance methodology, environmentally friendly funds underperform SRI funds but, show similar or superior performance compared with conventional funds.

Muñoz et al. (2014) also discussed the financial performance of US and European green and conventional mutual funds. They demonstrated that, for the US, using domestic portfolios, green funds do not perform significantly worse than the market, revealing a neutral performance. However, using global portfolios, green funds show an underperformance relative to the market. For European green funds, the results are

very similar for the domestic and global portfolios, showing a neutral performance in relation to the market.

More recently, Silva and Cortez (2016) examined the performance of US and European green funds applying two conditional models. The first one allowed for time-varying alphas and betas, including the short-term rate and the default spread as information variables. The alternative model includes a dummy variable to distinguish between different economic states. These authors observed evidence that green funds underperform the benchmark, which was also supported by the individual results. Furthermore, considering the time-varying alpha coefficients, US green funds show lower performance in periods of higher interest rates. The European portfolios did not present statistically significant estimations. Considering the investment style, green funds seem to be more exposed to the market than other SRI funds and are strongly oriented to small capitalization stocks. For European funds, at the aggregate level, the HML factor coefficient indicates that these funds are value oriented. Silva and Cortez (2016) also suggest that there is a tendency for certified green mutual funds to perform better than green funds with no certification.

2.3 "Black" investment

2.3.1 Performance of black mutual funds

This dissertation also addresses the performance of funds that invest in companies concerning carbon-intensive activities, the so called black funds. The point is to compare the performance of these funds with the performance of green mutual funds, mainly because the entire world is reducing their activities related with the fossil fuel industry and there is an increasing investment in green activities. Following Ibunkle and Steffen (2017) a black fund invests in entities related to the "*extraction, facilitation, transportation, storage, processing, sale and use of natural resources*". Besides, this definition also concerns corporations linked to the mining of minerals, precious metals, ferrous and non-ferrous and to the fossil fuel industry, namely, companies involved in the oil, gas and coal sectors.

Financial literature concerning black funds is very rare. Ibikunle and Steffen (2017) performed a study precisely comparing portfolios of green, black and conventional funds. The authors did not find any significant differences between the risk-adjusted performance of green and black funds. However, over the last five years, green funds significantly outperform their black peers.

Besides, the empirical results of this article show that black mutual funds report a lower market risk than green mutual funds, and this lower performance justifies the inferior performance when using a global market index. Additionally, black mutual funds are more exposed to value stocks and small-cap stocks. In relation, to the momentum factor, the results are positive and statistically significant, indicating a tendency towards winner stocks. By contrast, when reducing the sample period, considering the period from 1991 to 2002, green mutual funds report a significantly negative momentum coefficient, demonstrating a higher exposure to losers' stocks.

Furthermore, when using a conventional benchmark, like the *FTSE Global Small Cap Index*, the adjusted coefficient of determination results were relatively low, but when they applied a black benchmark as the *S&P Global Natural Resources Index*, the explanatory power of the model changed considerably, showing an improvement.

2.3.2 Relationship between oil prices changes and clean energy

As it was mentioned before, financial literature concerning black funds is rare, however, there are some studies comparing alternative energy stocks and non-green stocks, as, for example, stocks from the fossil fuel industry.

As most empirical studies suggest, the rise of oil prices should increase the number of investments in clean energy firms (Kumar et al., 2012).

In recent years, environmental concerns are seen as a top priority, claiming the substitution of oil, a conventional fossil fuel energy, by clean energy sources (Kumar et al., 2012). As mentioned, the rise of oil prices should increase the number of investments in clean energy firms. Kumar et al. (2012) performed a study about clean energy firms,

oil markets and the carbon market, considering the period from April 2005 to November 2008. The authors conducted a Markov-switching VAR analysis, concluding that a shock in oil prices positively influences the stock prices of clean energy firms. Managi and Okimoto (2013) developed a similar study, but also considering structural alterations. The authors also, concluded that there is a positive relationship between oil and clean energy prices, verifying a change from conventional energy to clean energy.

Bohl et al. (2015) developed a study about the factors that drove the mid-2000s explosiveness in alternative energy stock prices. This analysis considered European, US and global indices. Empirical results, showed that for the U.S. market the alternative energy stocks are seen as a protection against the increase in petroleum prices, suggesting that investors may adopt a cost-benefit approach, in order to implement clean energy technologies. By another hand, for the European market the adoption of alternative energies approaches is almost independent from the changes in oil prices markets. Besides, the findings indicate that renewable energy stocks have a higher exposure to winner stocks, except for the US market, where the results were negative. For this reason, only in US market, positive payoffs from an investment in fossil fuel has a positive impact on renewable energy stocks. Additionally, all the indices show a higher exposure to small-cap and growth stocks.

2.4 Performance of SR and Green Funds in recession and expansion periods

Potentially the performance of SRI or more specifically green mutual funds, can be influenced by the state of the economy.

For the US market, Climent and Soriano (2011), concluded that, in recession periods, SRI, conventional and green funds show worse performance than in expansion periods. In the case of green funds, this bad performance during turmoil periods may be explained by the uncertainty of government policies, which directly influences green investing.

Nofsinger and Varma (2014), examined a sample of 240 US domestic SRI funds, from 2000 to 2011. This study analyses the performance ATG (Alcohol, Tobacco, and

Gambling), ESG and religion funds during periods of recession and expansion. They found an outperformance of ESG funds during bad economic states when compared with their conventional peers. During expansion periods, ESG funds underperform conventional funds. In turn, the findings did not indicate an outperformance of ATG and faith or religious funds during crisis periods. Contrariwise, religious funds present an underperformance during the market recession. When applying the positive screening approach for ESG characteristics the result is the same, indicating an outperformance during trouble times periods. Furthermore, the authors defend that the positive socially responsible characteristics of firms make them less risky in recession periods.

For the European market, Leite and Cortez (2015) investigated the performance of French socially responsible funds during a market crisis. The authors identified three different periods of crisis, from 2001 to 2012 following Pagan and Sossounov's (2003) approach. The first period is associated with the crash of the technology bubble of the 2000's (January 2001 to March 2003). The second is linked to the global financial crisis (from 2007 to 2009) and the third to the euro debt crisis (May 2011 to May 2012). Considering the recession and expansion analysis, socially responsible funds underperform their conventional peers in good economic periods but present no statistically significant differences during bad economic periods. Concerning the investment style, comparing with conventional funds, during expansion periods socially responsible funds are more exposed to the market and local factors and less exposed to size and book-to-market factors. Besides, both types of funds show a higher tendency towards value stocks during bad economic states.

Becchetti et al. (2015) analysed a period from January 1992 to April 2002, including the dot-com crisis and the global financial crises and several markets. This study compares the performance of socially responsible funds (SRF) and conventional funds (CF), concluding that socially responsible funds outperform their conventional peers during bad market states, in line with the findings of Nofsinger and Varma (2014). This conclusion demonstrates that socially responsible funds may be seen as insurance during the global financial crisis.

Ibikunle and Steffen (2017) also gave some attention to periods of crisis, like the Eurozone crisis from 2009 to 2011 and the global financial crisis from 2007 to 2009,

suggesting that during these periods the financial activities for environmentally-friendly pursuits were limited, due to the bad stage of worldwide economies. They found that in recession periods green mutual funds improved their performance, reducing their enormous underperformance compared to their conventional peers.

Leite et al. (2018) identified two recession periods for Sweden (June 2007 to January 2009; and May to September 2011) and three for Europe (November 2002 to March 2003; June 2007 to March 2009; and January 2010 to September 2011) from November 2002 to October 2012. At the aggregate level, the findings demonstrate that socially responsible funds investing globally present a inferior performance in recession periods. However, at the individual level, the majority of these SR funds reveal similar performance, in expansion and recession periods, except one fund. Concerning the portfolio's differences, both types of funds show similar performance during bad and good economic states, except funds investing in Sweden. These funds underperform their conventional matches. The conclusions are not consistent with previous, for example, Nofsinger and Varma (2014).

Lastly, for both markets, Muñoz et al. (2014), using global portfolios, found that US green funds underperform the market in expansion periods, but there are no significant changes of performance, in recession periods. Although the results are not statistically significant, US green funds improved their performance in turmoil periods. For European green funds, the results were slightly different indicating that, these funds perform similarly in expansion and recession periods.

Silva and Cortez (2016), also showed some concern about crisis periods, creating a dummy variable to distinguish periods of crisis from periods of non-crisis. The results showed an underperformance of US and European green funds in expansion periods and a higher performance in recession periods. However, for the US market the results are positive and statistically significant, suggesting an increase in performance during bad economic periods. But for the European funds the results are not statistically significant, indicating no change in performance. These results are slightly different from the results obtained by Muñoz et al. (2014), namely in the case of European green funds.

3. Methodology

In this section, the methodology applied in this study will be presented in detail. First, the Carhart (1997) four-factor model and the Fama and French (2015) five-factor model in their unconditional form will be described. Additionally, the models to assess funds' performance in different market states will be presented.

3.1 Unconditional models: Carhart (1997) four-factor model and Fama and French (2015) five-factor model

The Carhart (1997) four-factor model, is an improvement of CAPM model and Fama and French (1993) three-factor model and is widely applied in performance evaluation. The model includes the market (MKT), size (SMB), book-to-market (HML) and a momentum (MOM) factors. The size (SMB – small minus low) presents the difference in returns between a portfolio of small stocks and a portfolio of large stocks. Positive (negative) and statistically significant values indicate a higher exposure to small (large) stocks. The HML (high minus low) factor reports the difference between a portfolio of high book-to-market stocks and a portfolio of low book-to-market stocks. Positive (negative) and statistically significant values indicate a higher exposure to value (growth) stocks. In addition to the Fama and French (1993) three-factor model, the Carhart (1997) model includes the MOM factor. This factor captures the difference in returns of a portfolio of past winners and a portfolio of past losers. The unconditional Carhart (1997) model assumes the following form:

$$r_{p,t} = \alpha_p + \beta_{MKT}\, r_{m,t} + \beta_{SMB}(SMB_t) + \beta_{HML}\,(HML_t) + \beta_{MOM}(MOM_t) + \varepsilon_{p,t} \quad (1)$$

where , $r_{p,t}$ is the excess return of portfolio *p* over month *t,* $r_{m,t}$ **,** is the market´s excess return over month *t* , α_p , is the four- factor-adjusted return of the portfolio, β_{MKT} represents the systematic risk of the portfolio, the $HML_{t,}$, $SMB_{t,}$ and MOM_t represent value, size and momentum factors and β_{HML}, β_{SMB} and β_{MOM} are the factor coefficients, and ε_t is the error term. In the above model, a negative (positive) and statistically

significant alpha suggests an underperformance (outperformance) of the fund in relation to the market benchmark.

Fama and French (2015) proposed the five-factor model as an improved version of the Fama and French (1993) three-factor model. This new model advocates the use of two additional factors, namely the profitability (RMW) and investment (CMA) factors. Following Fama and French (2015), the RMW factor represents the difference between the returns of stocks with robust and weak profitability and the CMA factor stands for the difference between the returns of stocks of low (conservative) and high (aggressive) investment companies. The unconditional five-factor model assumes the following form:

$$r_{p,t} = \alpha_p + \beta_{MKT}\, r_{m,t} + \beta_{SMB}(SMB_t) + \beta_{HML}(HML_t) + \beta_{RMW}(RMW_t) + \beta_{CMA}(CMA_t) + \varepsilon_{p,t} \quad (2)$$

where , $r_{p,t}$ is the excess return of portfolio *p* over month *t,* $r_{m,t}$ **,** is the market´s excess return over month *t*, β_{MKT} represents the systematic risk of the portfolio, the $HML_{t,}$, $SMB_{t,}$ and RMW_t and CMA_t represent value, size, profitability and investment factors. The β_{HML}, $\beta_{SMB,}$ β_{RMW} and β_{CMA} are the factors coefficients, and ε_t is the error term.

3.2 Conditional models: conditional Carhart (1997) four-factor model and conditional Fama and French (2015) five-factor model

The above models do not consider information about economic conditions and therefore results based on such models are potentially biased (Christopherson et al., 1998). To solve this problem, Ferson and Schadt (1996) developed a model that allows the market risk (beta) to change over time, although the alpha remains constant.

Later, Christopherson et al. (1998) improved Ferson and Schadt (1996) model by allowing, not only the market risk (beta), but also the performance measure (alpha) to be time varying. Ferson et al. (2008) gave further support for the time-varying alpha term in the model. In this version of the model, the conditional alphas and betas are

considered as a linear function of a vector of predetermined information variables, Z_{t-1}, that represents the public information available at time t-1.

The conditional four-factor model assumes the following form:

$$r_{p,t} = \alpha_p + \alpha_{TB}(TB_{t-1}) + \alpha_{DY}(DY_{t-1}) + \beta_{MKT} r_{m,t} + \beta_{MKT*TB}(TB_{t-1} * r_{m,t}) + \beta_{MKT*DY}(DY_{t-1} * r_{m,t}) + \beta_{SMB}(SMB_t) + \beta_{SMB*TB}(TB_{t-1} * SMB_t) + \beta_{SMB*DY}(DY_{t-1} * SMB_t) + \beta_{HML}(HML_t) + \beta_{HML*TB}(TB_{t-1} * HML_t) z_{t-1} + \beta_{HML*DY}(DY_{t-1} * HML_t) + \beta_{MOM}(MOM_t) + \beta_{MOM*TB}(TB_{t-1} * MOM_t) + \beta_{MOM*DY}(DY_{t-1} * MOM_t) + \varepsilon_{p,t} \quad (3)$$

where α_p represents the conditional performance measure, TB_{t-1} and DY_{t-1} represent the public information variables. α_{TB}, and α_{DY} represent the response of the conditional alpha to the short-term rate (TB) and dividend yield (DY) information variables. Positive (negative) α_{TB} results suggest a higher (lower) performance in time of higher interest rates. Positive coefficients of α_{DY} indicate a higher (lower) performance in times of higher dividends. β_{MKT*TB}, β_{MKT*DY}, β_{SMB*TB}, β_{SMB*DY}, β_{HML*TB}, β_{HML*DY}, β_{MOM*TB}, β_{MOM*DY} present the conditional betas coefficients.

$$r_{p,t} = \alpha_p + \alpha_{TB}(TB_{t-1}) + \alpha_{DY}(DY_{t-1}) + \beta_{MKT} r_{m,t} + \beta_{MKT*TB}(TB_{t-1} * r_{m,t}) + \beta_{MKT*DY}(DY_{t-1} * r_{m,t}) + \beta_{SMB}(SMB_t) + \beta_{SMB*TB}(TB_{t-1} * SMB_t) + \beta_{SMB*DY}(DY_{t-1} * SMB_t) + \beta_{HML}(HML_t) + \beta_{HML*TB}(TB_{t-1} * HML_t) z_{t-1} + \beta_{HML*DY}(DY_{t-1} * HML_t) + \beta_{RMW}(RMW_t) + \beta_{RMW*TB}(TB_{t-1} * RMW_t) + \beta_{RMW*DY}(DY_{t-1} * RMW_t) + \beta_{CMA}(CMA_t) + \beta_{CMA*TB}(TB_{t-1} * CMA_t) + \beta_{CMA*DY}(DY_{t-1} * CMA_t) + \varepsilon_{p,t} \quad (4)$$

where α_p represents the conditional performance measure, TB_{t-1} and DY_{t-1} represent the public information variables. α_{TB}, and α_{DY} represent the response of the conditional alpha to the short term rate (TB) and dividend yield (DY) information variables. β_{MKT*TB}, β_{MKT*DY}, β_{SMB*TB}, β_{SMB*DY}, β_{HML*TB}, β_{HML*DY}, β_{RMW*TB} β_{RMW*DY}, β_{CMA*TB}, and β_{CMA*DY} present the conditional betas coefficients.

3.4 Models for recession and expansion periods

Besides the use of conditional models, an alternative approach to study the impact of the state of the economy in the performance of the mutual funds is to add a dummy variable to the unconditional performance evaluation models. The inclusion of a dummy variable enables us to analyse the performance of green and black mutual funds over different market states. Following, for example, Silva and Cortez (2016), and Leite et al. (2018) a dummy variable was added, to distinguish between crisis and non-crisis periods, to the Carhart (1997) unconditional model. This dissertation will also add a dummy variable to the Fama and French (2015) unconditional model.

The Carhart (1997) model including a dummy variable assumes the following expression:

$$r_{p,t} = \alpha_{0,p} + \alpha_{rec,p}D_t + \beta_{MKT,p}r_{m,t} + \beta_{MKTrec,p}D_t + \beta_{SMB,p}(SMB_t) + \beta_{SMBrec,p}(SMB_t)D_t + \beta_{HML,p}(HML_t) + \beta_{HMLrec,p}(HML_t)D_t + \beta_{MOM,p}(MOM_t) + \beta_{MOMrec,p}(MOM_t)D_t + \varepsilon_{p,t} \quad (5)$$

where D_t is a dummy variable which assumes a value of 1 in recession periods and the value of 0 in expansion periods. Thus, $\alpha_{0,p}$ represents the performance measure in good economic conditions and $\alpha_{rec,p}D_t$ represents the performance differentials in recession periods. This means that the performance in bad economic states is given by the alpha in expansion ($\alpha_{0,p}$) plus the alpha associated to the dummy variable ($\alpha_{rec,p}$). This alpha ($\alpha_{rec,p}$) is the increase (decrease) of performance in recession periods. If statistically significant we interpret saying that the performance differs significantly in recession and expansion periods. Accordingly, β_{MKTrec}, β_{SMBrec}, β_{HMLrec}, β_{MOMrec} represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML) and momentum (MOM) factors for crisis periods. The ε_t is the error term.

Following the same procedure, the Fama and French (2015) model including a dummy variable is illustrated by the following expression:

$$r_{p,t} = \alpha_{0,p} + \alpha_{rec,p}D_t + \beta_{MKT,p}r_{m,t} + \beta_{MKTrec,p}D_t + \beta_{SMB,p}(SMB_t) + \beta_{SMBrec,p}(SMB_t)D_t + \beta_{HML,p}(HML_t) + \beta_{HMLrec,p}(HML_t)D_t + \beta_{RMW,p}(RMW_t) + \beta_{RMWrec,p}(RMW_t)D_t + \beta_{CMA,p}(CMA_t) + \beta_{CMArec,p}(CMA_t)D_t + \varepsilon_{p,t} \quad (6)$$

where D_t is a dummy variable Thus, $\alpha_{0,p}$ represents the performance measure in good economic conditions and $\alpha_{rec,p}D_t$ represents the performance differentials in recession periods. This means that the performance in bad economic states is given by the alpha in expansion ($\alpha_{0,p}$) plus the alpha associated to the dummy variable ($\alpha_{rec,p}$). This alpha ($\alpha_{rec,p}$) is the increase (decrease) of performance in recession periods. The β_{MKTrec}, β_{SMBrec}, β_{HMLrec}, $\beta_{RMWrec,}$ and β_{CMArec} represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML), profitability (RMW), and investment (CMA) factors for crisis periods. The ε_t is the error term.

4. Data

This chapter describes the sources and the selection process used to obtain the green and black funds sample. It also presents relevant information about all the variables used in performance evaluation models, including risk factors and public information variables. The process to define the recession and expansion periods is also explained in this chapter.

4.1 Portfolios formation

The funds and *benchmark*s monthly returns were computed discretely, in US dollars.

The portfolios' returns for green and black mutual funds are computed based in the equally weighted and a value weighted method. The equally weighted portfolio is constructed based in average monthly excess returns of each fund and the value-weighted portfolio also considers the total net asset value (TNA) of each fund.

4.2 Data sources and selection process

Data was collected from the *Thomson Reuters Eikon* platform. This dissertation focuses on green and black mutual funds domiciled in Europe, with a Global investment focus. Data was collected from the time period from December 2003 to November 2019.

The sample respects to European countries and considering the number of socially responsible funds domiciled in each country, based on the information of the study by Veigo Eiris (2016), six European countries (with the Euro as the official currency) were selected for analysis: France, Netherlands, Germany, Belgium, Austria and Finland.

The selection process of the funds was very complex and time consuming. The entire universe of mutual funds from the six European countries mentioned above, was downloaded from *Thomson Reuters Eikon* platform. Next, a manual selection was implemented, in order to include only equity mutual funds with a global focus. Furthermore, to ensure that only green mutual funds were included in the sample, the Key Investor Information Document (KIID) and the prospectus documents were analysed

in detail, in order to clearly understand the true investment strategies of each fund. The final sample includes funds, that demonstrate a strong commitment with environmental activities. All the other funds were eliminated.

The process to select black funds was similar, but when doing the manual selection[1], the focus was in mutual funds presenting commitment with fossil energy and natural resources. Once again, the official investor documents were analysed to ensure the samples' quality. In some cases the official investor documents are not available in English, and the translation of the text has been performed using Google Translate and Deepl.[2]

To ensure consistency, funds with limited or no available information were excluded from the sample.

Following Ibikunle and Steffen (2017), to ensure the data quality, same-class funds and funds listed in more than one country were identified and cleaned from the sample. Considering the same-class funds, the oldest one was selected. Additionally, and to avoid some survivorship bias merged, and liquidated funds were also selected. Finally, funds with less than 30 monthly observations were excluded from the sample.

4.3 Risk factors and market benchmarks

The risk factors were obtained from *Professor's Kenneth R. French* website[3]. The data file contains information about the size (SMB), book-to-market (HML), momentum (MOM), profitability (RMW) and investment (CMA) risk factors. Furthermore, global factors were selected, as the funds used in this sample have a global investment orientation (Cortez et al.,2009; Ibikunle and Steffen, 2017).

[1] Note that, this manual selection of green and black mutual funds does not intend to define how green is green or how black is black. As the standards of this definition may be different from person to person and there is no intention to participate in this discussion.
[2] For this reason, the inclusion or exclusion decision of green and black mutual funds is related to the quality of the translation obtained with these tools.
[3] https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

The one-month Treasury Bill rate was acquired from the *Professor Kenneth R. French Website* is used as the risk-free rate proxy.

Concerning the market *benchmarks*, the *FTSE All-World Index* is applied as a conventional global market index. Additionally, sector benchmarks are also applied. Considering the green funds, the regressions are repeated using the *FTSE4GOOD Global Index,* a socially responsible index, as the market proxy and for black funds the analysis is repeated using the *FTSE All-World Mining*. Other alternative *benchmarks* were tested to green and black mutual funds, in particular the *FTSE Environmental Opportunities All-Share Index*[4] and the *S&P Global Natural Resources Index*[5]. However, the explanatory power of the models, as measured by the adjusted R^2, was lower when these alternatives were used.

4.4 Public information variables

For the conditional models, two lagged information variables are used: the short-term rate (TB) and the dividend yield (DY). These variables are widely applied in most of the empirical studies up to date (Cortez et al., 2009). The funds considered in this dissertation invest globally, and for this reason the US market is seen as the global market proxy following the approach of Cortez et al. (2012). The short-term rate is the yield on a constant maturity 3-month US Treasury Bill[6], obtained by the *Federal Reserve website*. The dividend yield is based on the *FTSE All World Index*. The time series was acquired from *Thomson Reuteurs Datastream.* In order to avoid biased results, these two variables were detrended by subtracting a 12-month moving average, as suggested by Ferson et al. (2003). Additionally, to avoid scale effects, these two variables are used in their corresponding mean zero values (Bernhardt and Jung, 1979).

[4] Individual results for unconditional and conditional models are presented in appendices: 27, 28, 31, and 32.
[5] Individual results for unconditional and conditional models are presents in appendices: 29, 30, 33, and 34,
[6] https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H15

4.5 Recession and expansion periods

The Centre for Economic Policy Research [7](CEPR) presents information about the Euro Area business cycles, identifying the peaks and troughs for this area since 1974. The committee defines a recession as *"a significant decline in the level of economic activity, spread across the economy of the euro area, usually visible in two or more consecutive quarters of negative growth in GDP, employment and other measures of aggregate economic activity for the euro area as a whole."* The economy is facing a recession between a peak and through and is facing an expansion between a trough and peak. Between the full period from December 2003 to November 2019, it was possible to identify two recession periods[8]. The first period is from April 2008 to June 2009 and the second period is from October 2011 to March 2013.

4.6 Descriptive Statistics

End-of-month returns information was collected from *Datastream.* The funds and *benchmark*s monthly returns were computed discretely.

The total sample used in this study includes 49 investment funds, being 21 green mutual funds and 28 black mutual funds. Concerning green mutual funds, the total sample includes: France (8), Netherlands (1), Germany (3), Belgium (4), Austria (2) and Finland (3). Regarding black mutual funds, the final sample contains: France (17), Netherlands (0), Germany (4), Belgium (1), Austria (5), and Finland (0). [9]

[7] https://cepr.org/data
[8] https://eabcn.org/dc/chronology-euro-area-business-cycles
[9] Detailed information about each fund is presented in appendices 1 and 2.

4.7 Summary Statistics

Table 1: Summary of descriptive statistics: green and black mutual funds

Table 1 reports the descriptive analysis of monthly excess returns of the equally and value weighted portfolios of green and black mutual funds. The average, standard deviation, minimum, maximum, skewness, kurtosis values and the probability value of the Jarque-Bera teste are presented, considering the period from December 2003 to November 2019. Similar statistics are also reported for market indices and risk factors.

Table 1 Summary of descriptive statistics: green and black mutual funds

	Average	Standard Deviation	Minimum	Maximum	Skewness	Kurtosis	JB *p-value*
Equally-W: green mutual funds	0.00509	0.0516	-0.257	0.138	-1.083	6.863	0.000
Value W: green mutual funds	0.00522	0.0532	-0.273	0.158	-1.195	7.900	0.000
Equally W: black mutual funds	0.00354	0.0740	-0.326	0.248	-0.253	4.735	0.004
Value W: black mutual funds	0.00459	0.0788	-0.341	0.242	-0.337	4.730	0.002
MKT	0.00648	0.0422	-0.195	0.114	-0.875	5.731	0.000
SMB	0.000298	0.0143	-0.0348	0.0395	0.0366	2.848	0.950
HML	-1.77e-05	0.0169	-0.0461	0.0459	0.0664	3.287	0.559
RMW	0.00323	0.0106	-0.0277	0.0342	-0.0279	3.072	0.891
CMA	0.000344	0.0131	-0.0406	0.0601	0.753	6.549	0.000
MOM	0.00378	0.0326	-0.243	0.0922	-2.433	19.56	0.000
FTSE4GOOD Global Index	0.00614	0.0434	-0.186	0.126	-0.709	5.073	0.000
FTSE All-World Index	0.00651	0.0428	-0.200	0.121	-0.824	5.867	0.000
FTSE All-World Mining Index	0.00765	0.0837	-0.313	0.234	-0.263	4.187	0.016

Table 3 reports the descriptive analysis of equally-weighted and value-weighted portfolios of green and black mutual funds. It also reports statistics for the market *benchmarks* and the additional risk factors. Both portfolios of green and black mutual funds and the market *benchmarks* present positive average. In relation to the risk factors, only book-to-market (HML) factor shows a negative value. Green portfolios show higher average than black portfolios, with value-weighted portfolios having the highest values, green (0.00522) and black (0.00459). Regarding the market *benchmarks,* the *FTSE All-World Mining Index*, shows higher average (0.00765). In comparison to the market (MKT) risk factor value (0.00648), the conventional *benchmark*, *FTSE All-World Index*, shows the most similar average (0.00651). Concerning the standard deviation, the portfolio with the highest value is the value-weighted portfolio of black mutual funds (0.0786). Regarding market indices, the black *benchmark* reports the highest value

(0.0837). Besides, the social and the conventional *benchmarks* present very similar values, 0.0434 and 0.0428, respectively.

Additionally, both green and black portfolios show negative skewness and positive excess kurtosis values. The Jarque-Bera test also suggests that, the null hypothesis of excess returns being normally distributed is rejected at a 5% level for both green and black portfolios. This conclusion supports the use of conditional models as stated by Adcock et al. (2012). Considering the market *benchmarks,* the normality hypothesis is also rejected.

5. Empirical Results

This chapter reports and discusses the empirical results obtained by the application of the unconditional and conditional performance evaluation models[10].

Another assumption is that the errors are linearly independent of one another, meaning that the covariance between the error terms is zero (Brooks, 2014). To test for autocorrelation problems a Breusch-Godfrey test, with 5 lags, was applied.

The violation of this assumptions leads to unbiased results and for this reason the correction of standard deviations for heteroscedasticity and autocorrelation problems is fundamental. The White (1980) *robust* procedure is used, whenever appropriate, to correct for heteroscedasticity. In the presence of both heteroscedasticity and autocorrelation the procedure suggested by Newey and West (1994) is applied.

To conclude about a significant difference in the performance of green versus black funds, a new portfolio, ((1)-(2)), was created by the difference between green mutual funds returns and black mutual funds. This procedure was implemented for both equally and value-weighted portfolios. This difference allows us to compare the performance between the two types of funds and to compare their investment style.

5.1 Empirical Results using Unconditional models

5.1.1 Carhart (1997) four-factor model

Table 2 reports the estimation results of green and black mutual funds for the unconditional Carhart (1997) four-factor model, using the FTSE All-World Index, FTSE4GOOD Global Index, and FTSE All-World Mining Index as market proxies. The

[10] The models were estimated by an Ordinary Least Squares (OLS) regression. The proper use of OLS estimator implies the respect for some assumptions. One of the assumptions of the *Classical Linear Regression Model* (CLRM) is that the variance of the errors is constant and finite over all values of x_t. (Brooks, 2014). If this assumption is violated, the errors are said to be heteroscedastic. To verify the presence of heteroscedasticity the White (1980) test was applied

results at the individual level, for each fund, are summarised in the table and detailed results are presented in appendices 3, 4, 5 and 6.

Table 2. Empirical Results for Unconditional Carhart (1997) four-factor model

The table reports regression estimates for equally and value weighted portfolios, considering the period December 2003 to November 2019. The results are obtained by the regression of the unconditional Carhart (1997) four-factor model (eq. 1), using three alternative indices: Panel A reports empirical results for green and black mutual funds, using the FTSE All-World Index, Panel B presents estimations concerning only green funds, applying the FTSE4GOOD Global Index and Panel C shows the results for black funds, using the FTSE All-World Mining Index as market proxy. This table also reports the portfolios' difference between green and black funds.
Additionally, the performance estimates (α_p), the systematic risk (β_{MKT}), the adjusted coefficient of determination ($Adj.\ R^2$) and the regression coefficients of size (SMB), book-to-market (HML) and momentum (MOM) factors are presented. The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level.

Panel A: FTSE All-World Index							
		α_p	**β_{MKT}**	**β_{SMB}**	**β_{HML}**	**β_{MOM}**	**Adj. R^2**
Green mutual funds (1)	**Equally W.**	-0.0029**	1.1457***	0.5102***	-0.0049	0.0930**	0.9089
	Value W.	-0.0028**	1.1672***	0.6006***	-0.0810	0.0566	0.9007
	N+	2 [0]	23 [23]	20 [15]	6 [1]	13 [2]	-
	N-	19 [10]	0 [0]	1 [0]	15 [4]	8 [1]	-
Black mutual funds (2)	**Equally W.**	-0.0044	1.0843***	1.0453***	-0.1917	0.1359	0.4194
	Value W.	-0.0042	1.2390***	1.0001***	-0.1291	0.1142	0.4723
	N+	2 [0]	28 [28]	28 [23]	12 [6]	19 [2]	-
	N-	26 [7]	0 [0]	0 [0]	16 [0]	9 [1]	-
Portfolio Difference	**EW: (1) - (2)**	0.0014	0.0635	-0.5529**	0.2005	-0.0387	0.0074
	VW: (1) - (2)	0.0014	-0.0731	-0.4036	0.0517	-0.0552	-0.0067
Panel B: FTSE4GOOD Global Index							
Green Mutual funds							
		α_p	**β_{MKT}**	**β_{SMB}**	**β_{HML}**	**β_{MOM}**	**Adj. R^2**
Equally W.		-0.0024*	1.1204***	0.6938***	-0.0840	0.1110**	0.8806
Value W.		-0.0023	1.1403***	0.7877***	-0.1615	0.0744	0.8716
N+		3 [0]	21 [21]	21 [18]	5 [0]	13 [2]	-
N-		18 [10]	0 [0]	0 [0]	16 [5]	8 [0]	-
Panel C: FTSE All-World Mining Index							
Black Mutual funds							
		α_p	**β_{MKT}**	**β_{SMB}**	**β_{HML}**	**β_{MOM}**	**Adj. R^2**
Equally W.		-0.0026	0.7902***	0.5735***	-0.2734**	-0.0176	0.8420
Value W.		-0.0021	0.8826***	0.4794***	-0.2189**	-0.0692	0.9155
N+		3 [0]	28 [28]	25 [13]	9 [2]	13 [0]	-
N-		25 [1]	0 [0]	3 [0]	19 [9]	15 [8]	-

Analysing table 2, when using the *FTSE All-World Index* as a market proxy, both equally and value-weighted portfolios present negative and statistically significant alphas, indicating an underperformance of green mutual funds in relation to the market. This is consistent with Silva and Cortez (2016), which also concluded that European green mutual funds tend to underperform the benchmark. Concerning individual analysis, the alphas show a negative tendency, with 19 funds with negative alpha coefficient and 2 funds with positive alpha coefficient. As for the funds with negative alphas 10 funds are statistically significant at 5% level. With respect to black mutual funds, the values for the alphas are negative, but they are not statistically significative, suggesting a neutral performance. At an individual level, at a significance level of 5%, 7 funds exhibit a negative and statistically significant alpha.

Regarding panel B, the equally-weighted portfolios shows negative and a statistically significant alpha at a 10% level, which suggests an underperformance of green mutual funds in relation to the market, when *FTSE4GOOD Global Index is used as a benchmark*. By contrast, for the value-weighted portfolios the alpha coefficient is negative but not statistically significant. When using this *benchmark*, the alphas show a negative tendency, with 10 funds presenting a negative and statistically significant (at a 5% level) alpha coefficient. Concerning Panel C, black mutual funds show a neutral performance. At the individual fund level, almost all the funds report neutral performance, except 1 fund which shows a negative and statistically significant alpha coefficient at a 5% level.

As expected, the coefficient for the market risk is positive and statistically significant at a 1% level for both the green and black funds, not only at an aggregate level (EW and VW portfolios) but also at the individual level.

For green funds the values for the market risk coefficient are higher when using the *FTSE All-World Index* as a market proxy, showing that green funds are more sensitive to the conventional *benchmark*. This result is in line with the results of Cortez et al. (2009) and Leite and Cortez (2014). Yet, green funds also present a higher value of the adjusted R^2 with respect to *the FTSE All-World Index* in comparison to the value of the

adjusted R^2 when the *FTSE4GOOD Global Index* is used. For black funds, the value for the adjusted R^2 is quite low when applying the *FTSE All-World Index,* in comparison to the value of the adjusted R^2 when the *FTSE All-World Mining Index* is used, suggesting the low exposure of this type of funds to the conventional index. This finding is consistent with Ibikunle and Steffen (2017). Although, the results were not presented, the authors wrote a footnote with this conclusion.

Additionally, Panel A results also indicate that green funds are slightly more sensitive to market risk than black mutual funds when considering the equally-weighted portfolio, which is in line with Ibikunle and Steffen (2017) results. However, when concerning the value-weighted portfolio the black funds are more exposed to market risk than green funds.

Considering the size (SMB) factor, the three panels present positive values. The results are positive and statistically significant at a 5% level, meaning that green and black mutual funds are more exposed to small cap stocks, which is consistent with Ibikunle & Steffen (2017). Individually, there is clear evidence of a positive tendency across all the funds. Furthermore, the portfolios' difference for the SMB factor is negative and statistically significant, indicating that green funds are significantly less exposed to small cap stocks than black funds.

In relation to the book-to-market (HML) factor, Panel A shows both green and black portfolios with negative results, however there is no evidence of statistical significance, which suggest that this risk factor has a neutral influence in explaining the portfolios returns. For green funds with *FTSE4GOOD Global Index* as a benchmark, conclusions are similar. In relation to black funds with the *FTSE All-World Mining Index*, the HML coefficient is negative and statistically significant at a 5% significance level, suggesting that this type of funds are more exposed to growth stocks. This is not consistent with Ibikunble and Steffen (2017) study, as their results showed a tendency to value stocks.

Additionally, in Panel A the equally-weighted portfolio reveals that green mutual funds are more exposed to winner stocks. At an individual level, the momentum factor shows neutral tendency, with the great majority of the funds exhibiting neutral values,

at a 5% significance level, for the MOM factor. These results are in line with the findings of Silva and Cortez (2016).

For black funds, the MOM factor indicates neutral explanatory power to the performance of these funds. These results, for both green and black funds, are robust to the use of non-conventional indices.

Finally, the results for the differences portfolios, allows us to conclude that there is no significant difference between the performance of green and black funds.

5.1.2 Fama and French (2015) five-factor model

Table 3 reports the estimation results of green and black mutual funds for the unconditional Fama and French (2015) five-factor model, using the *FTSE All-World Index*, *FTSE4GOOD Global Index* and *FTSE All-World Mining* as market proxies. The results at the individual level, for each fund, are summarised in the table and detailed results are presented in appendices 7, 8, 9, and 10.

Examining table 3, the performance of green and black funds does not differ much from the reported in the unconditional four-factor model. In this way, when applying the *FTSE All-World Index* as the market proxy, both green portfolios present a negative and statistically significant (at a 5% level) alpha coefficient, suggesting that green mutual funds underperform the market. With respect to black mutual funds, both portfolios report negative but not statistically significant results, indicating a neutral performance.

The only difference in the results is when the *FTSE4GOOD Global Index* is used as a *benchmark,* as both portfolios reveal negative but not a statistically significant estimates, indicating a neutral performance of green funds. The four-factor model results (those of table 2), exhibited a value-weighted portfolio with negative and statistically significant alpha coefficient at a 10% level, also suggesting an underperformance.

Table 3. Empirical Results for Unconditional Fama and French (2015) five-factor model

The table reports regression estimates for equally and value weighted portfolios, considering the period December 2003 to November 2019. The results are obtained by the regression of the unconditional five-factor model (eq. 2), using three alternative indices: Panel A reports empirical results for green and black mutual funds, using the FTSE All-World Index, Panel B presents estimations concerning only green funds, applying the FTSE4GOOD Global Index and Panel C shows the results for black funds, using the FTSE All-World Mining Index as market proxy. This table also reports the portfolios' difference between green and black funds. This table also reports the difference between the two portfolios.
Additionally, the performance estimates (α_p), the systematic risk (β_{MKT}), the adjusted coefficient of determination ($Adj.\ R^2$) and the regression coefficients of size (SMB), book-to-market (HML) and investment (CMA) and profitability (RMW) factors are presented. The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level.

Panel A: FTSE All World Index								
		α_p	**β_{MKT}**	**β_{SMB}**	**β_{HML}**	**β_{CMA}**	**β_{RMW}**	**Adj. R^2**
Green Mutual funds (1)	**Equally W.**	-0.0029**	1.1248***	0.5345***	0.0147	-0.0800	0.1758	0.9070
	Value W.	-0.0031**	1.1434***	0.6141***	0.0132	-0.1725	0.2184*	0.9020
	N+	2 [0]	21 [21]	21 [17]	9 [0]	13 [0]	14 [2]	-
	N-	19 [10]	0 [0]	0 [0]	12 [2]	8 [2]	7 [1]	-
Black Mutual funds (2)	**Equally W.**	-0.0025	0.9189***	0.9435***	0.1310	-0.9572	0.0332	0.4297
	Value W.	-0.0024	1.0655***	0.8846***	0.2477	-1.0480	0.0384	0.4848
	N+	3 [0]	28 [28]	28 [20]	15 [5]	7 [2]	15 [1]	-
	N-	25 [6]	0 [0]	0 [0]	13 [0]	21 [4]	13 [1]	-
Portfolio Difference	**EW: (1) - (2)**	-0.0005	0.2080*	-0.4253	-0.1075	0.8832	0.1442	0.0255
	VW: (1) - (2)	-0.0007	0.0777	-0.2722	-0.2337	0.8835	0.1880	0.0095
Panel B: FTSE4GOOD Global Index								
Green Mutual funds								
		α_p	**β_{MKT}**	**β_{SMB}**	**β_{HML}**	**β_{CMA}**	**β_{RMW}**	**Adj. R^2**
Equally W.		-0.0024	1.0766***	0.6990***	0.0178	-0.2539	0.2406	0.8810
Value W.		-0.0025	1.0946***	0.7814***	0.0162	-0.3490**	0.2845*	0.8769
N+		1 [0]	21 [21]	21 [19]	9 [0]	11 [0]	17 [2]	-
N-		20 [9]	0 [0]	0 [0]	12 [1]	10 [3]	4 [0]	-
Panel C: FTSE All World Mining Index								
Black Mutual funds								
		α_p	**β_{MKT}**	**β_{SMB}**	**β_{HML}**	**β_{CMA}**	**β_{RMW}**	**Adj. R^2**
Equally W.		-0.0027	0.7907***	0.5695***	-0.2631	-0.0026	-0.0120	0.8411
Value W.		-0.0021	0.8803***	0.4551***	-0.1605	-0.0699	-0.0678	0.9145
N+		6 [0]	28 [28]	22 [12]	16 [8]	11 [7]	14 [0]	-
N-		22 [0]	0 [0]	6 [0]	12 [10]	17 [12]	14 [2]	-

The market risk coefficient also presents positive and statistically significant values. Green funds also show higher adjusted R^2 values for the *FTSE All-World Index* and black funds also exhibit higher adjusted R^2 when applying the *FTSE All-World Mining Index* as a *benchmark*.

In relation to the size (SMB) and book-to-market (HML) factors, Panel A, B and C report a higher exposure of green and black mutual funds to small cap stocks and present a neutral influence of the HML risk factor to explain the portfolios' returns.

The investment (CMA) factor coefficients are negative but not statistically significant for both green and black portfolios, when the *FTSE All-World Index* is applied as a *benchmark.* However, panel B results report a negative and statistically significant (at a 5% level) CMA coefficient for the value-weighted portfolio, showing a higher exposure of green funds to stocks of high (aggressive) investment companies. The individual analysis suggests neutral tendency for the investment factor. Concerning black mutual funds, when using the *FTSE All-World Mining Index,* the results are negative but not statistically significant. At the individual fund level, at a 5% significance level, 12 funds exhibit a negative and statistically significant CMA coefficient and 7 funds show positive and statistically significant investment coefficient.

In relation to the profitability (RMW) factor, for green funds, when the *FTSE All-World Index* and the *FTSE4GOOD Index* are used as a *benchmark* the value-weighted portfolios present positive and statistically significant RMW coefficient at a 10% level, showing a higher exposure to companies with robust profitability. The individual analysis shows a neutral tendency. For black funds, this risk factor indicates neutral power to explain the performance of these funds.

Although the results are very similar, the five-factor model reports slightly higher adjusted coefficients of determination than the four-factor model, except for black mutual funds when the *FTSE All-World Mining Index* is used, showing an explanatory power slightly lower for both equally-weighted and value-weighted portfolios. Additionally, when using the *FTSE All-World Index,* the green equally-weighted portfolio also shows a slightly lower adjusted R^2.

5.2 Empirical Results using Conditional models

In this section, the empirical results for the conditional model of Christopherson et al. (1998) are reported and discussed.

A Wald test was applied to all the models, testing the null hypothesis that the public information variables coefficients are equal to zero.

5.2.1 Conditional Carhart (1997) four-factor model

Table 4 reports the estimation results of green and black mutual funds for the conditional four-factor model, using the *FTSE All- World Index*, *FTSE4GOOD Global Index,* and *FTSE All-World Mining Index* as market proxies. The results at the individual level, for each fund, are summarised in the table and detailed results are presented in appendices 11, 12, 13, and 14.

Table 4 Empirical Results using Carhart (1997) four-factor mode

The table reports regression estimates for equally and value weighted portfolios, considering the period May 2008 to November 2019. The results are obtained by the regression of the conditional Carhart (1997) four-factor model (eq. 3), using three alternative indices: Panel A reports empirical results for green and black mutual funds, using the FTSE All-World Index, Panel B presents estimations concerning only green funds, applying the FTSE4GOOD Global Index and Panel C shows the results for black funds, using the FTSE All-World Mining Index as market proxy. This table also reports the portfolios' difference between green and black funds.

Additionally, it presents the performance estimates (α_p), the conditional alphas coefficients (α_{DY}, α_{TB}), the systematic risk (β_{MKT}), the conditional beta estimates (β_{MKT*DY}, β_{MKT*TB}, β_{SMB*DY}, β_{SMB*TB}, β_{HML*DY}, β_{MOM*DY}, and β_{MOM*TB}), the regression coefficients of size (SMB), book-to-market (HML), and momentum (MOM) factors and the adjusted coefficient of determination ($Adj.\ R^2$). The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. W1, W2 and W3 correspond to the probability values from the Wald test on the existence of time-varying alphas, time-varying betas and joint time-varying alphas and betas.

FTSE All-World Index										
	Green Mutual funds (1)				**Black Mutual funds (2)**				**Portfolio Difference**	
	Equally W.	**Value W.**	**N+**	**N-**	**Equally W.**	**Value W.**	**N+**	**N-**	**Equally W.**	**Value W.**
α_p	-0.0024**	-0.0024*	3 [2]	18[8]	-0.0035	-0.0034	6[0]	22[9]	0.0010	0.0009
α_{DY}	0.0042	0.0067	16[2]	5[1]	0.0186	0.0167	25[3]	5[0]	-0.0149	-0.0100
α_{TB}	-0.0002	0.0011	10[1]	11[0]	-0.0062	-0.0051	12[5]	16[0]	0.0059	0.0062
β_{MKT}	1.1610***	1.1562***	21[21]	0[0]	1.1385***	1.2759***	28[28]	0[0]	0.0267	-0.1208
β_{MKT*DY}	0.1457	0.0600	13[1]	8[0]	0.6108	0.6109	20[4]	8[0]	-0.4602	-0.5502
β_{MKT*TB}	0.0731	-0.0266	12[0]	9[2]	0.2269	0.2081	20[4]	8[3]	-0.1431	-0.2333
β_{SMB}	0.5415***	0.6250***	19[16]	2[0]	1.0511***	1.0144***	27[22]	1 [0]	-0.5277*	-0.3941
β_{SMB*DY}	0.8840***	0.8785***	15[4]	6[0]	2.1751*	2.5001**	23[4]	5 [0]	-1.3176	-1.6324
β_{SMB*TB}	0.2142	0.2366	12[1]	9[1]	0.2805	0.4649	22 [3]	6 [0]	-0.0484	-0.2302
β_{HML}	0.0499	-0.0006	10[4]	11[2]	0.0016	0.0908	16[7]	12[1]	0.0585	-0.0879
β_{HML*DY}	0.2186	0.1195	17[1]	4[1]	-0.0070	-0.2936	13[0]	15[0]	0.2338	0.4198
β_{HML*TB}	0.5186***	0.5644***	13[3]	8[1]	1.7075***	1.7247***	28[15]	0 [0]	-1.1866**	-1.1581**
β_{MOM}	0.0235	0.0404	11[0]	10[0]	-0.0070	-0.0289	10[0]	18 [1]	0.0313	0.0722
β_{MOM*DY}	0.1996*	0.0635	13[2]	8[1]	1.1282**	0.8786	24[5]	2[0]	-0.9282	-0.8149
β_{MOM*TB}	-0.0434	-0.0094	7[0]	14[3]	0.2566	0.1150	16[1]	12[0]	-0.3000	-0.1223
Adj. R^2	0.9208	0.9126	-	-	0.4754	0.5248	-	-	0.0370	0.0251
w1	0.7063	0.5505	-	-	0.3916	0.4924	-	-	0.5320	0.6370
w2	0.0001	0.0027	-	-	0.0003	0.0002	-	-	0.0452	0.0531
w3	0.0000	0.0000	-	-	0.0000	0.0000	-	-	0.0066	0.0127

Table 4 (continued)

Panel B: FTSE4GOOD Global Index					Panel C: FTSE All-World Mining Index				
Green Mutual funds					Black Mutual funds				
	Equally W.	**Value W.**	**N+**	**N-**		**Equally W.**	**Value W.**	**N+**	**N-**
α_p	-0.0021	-0.0021	4[0]	17[9]	α_p	-0.0014	-0.0011	4[0]	24[1]
α_{DY}	0.0016	0.0037	15[1]	6[1]	α_{DY}	0.0143	0.0088	15[7]	13[0]
α_{TB}	-0.0010	0.0002	10[2]	11[0]	α_{TB}	-0.0050	-0.0045	7[0]	21[0]
β_{MKT}	1.1292***	1.1221***	21[21]	0 [0]	β_{MKT}	0.8047***	0.8916***	28[28]	0[0]
β_{MKT*DY}	0.3440***	0.2658*	19[4]	2[0]	β_{MKT*DY}	0.0523	0.0826	13[0]	15[0]
β_{MKT*TB}	0.1243**	0.0271	13[0]	8[0]	β_{MKT*TB}	0.0224	0.0385	16[1]	12[2]
β_{SMB}	0.6874***	0.7706***	20[18]	1[0]	β_{SMB}	0.5662***	0.4584***	23[11]	5[0]
β_{SMB*DY}	1.0657***	1.0678**	16[8]	5[0]	β_{SMB*DY}	0.3610	0.5895	16[0]	12[0]
β_{SMB*TB}	0.2523	0.2606	13[2]	8[0]	β_{SMB*TB}	-0.6499**	-0.5580***	10[0]	18[7]
β_{HML}	0.0113	-0.0412	8[2]	13[3]	β_{HML}	-0.2472*	-0.1810	10[1]	18[9]
β_{HML*DY}	-0.0772	-0.1834	11[0]	10[0]	β_{HML*DY}	0.4942	0.2057	16[2]	12[2]
β_{HML*TB}	0.7308***	0.7855***	16[5]	5[0]	β_{HML*TB}	0.1840	0.0696	18[0]	10[0]
β_{MOM}	0.0550	0.0706	13[0]	8[0]	β_{MOM}	-0.0707	-0.1058	6[0]	22[7]
β_{MOM*DY}	0.2181	0.0785	9[2]	12[1]	β_{MOM*DY}	0.8202***	0.5535***	17[11]	11[1]
β_{MOM*TB}	-0.0277	0.0007	9[0]	12[1]	β_{MOM*TB}	0.2566	0.1284	16[1]	12[1]
Adj. R^2	0.9019	0.8927	-	-	**Adj. R^2**	0.8515	0.9217	-	-
w1	0.8470	0.8807	-	-	**w1**	0.0770	0.1441	-	-
w2	0.0000	0.0001	-	-	**w2**	0.0158	0.0005	-	-
w3	0.0000	0.0000	-	-	**w3**	0.0198	0.0005	-	-

Examining the table, the results are very similar with those obtained with the unconditional four-factor model.

When using the *FTSE All World Index* as the *benchmark,* the alpha coefficient for the equally-weighted portfolio is negative and statistically significant at a 5% level, suggesting an underperformance of green mutual funds in relation to the market. For the value-weighted portfolio, the results are negative and statistically significant at a 10% level, which slightly differs from the unconditional four-factor results, which presented a value weighted portfolio with a statistically significant alpha coefficient at a 5% level. Concerning black mutual funds, the alphas' coefficients are negative but not statistically significant, indicating a neutral performance of black funds.

With respect to the time-varying alpha coefficient, there is little evidence that funds' performance changes with different economic conditions. Analysing Panel A, B, and C, the alphas coefficients associated with the dividend yield and the short-term rate indicate a neutral influence in explaining the performance of green and black mutual

funds. At the individual fund level, the vast majority of green and black mutual funds also report not statistically significant alphas.

Furthermore, the risk factors conclusions for green and black funds are very similar with those from the unconditional four-factor model. As concluded previously, green and black mutual funds are more exposed to small cap stocks.

Considering the book-to-market (HML) factor, Panels A and B, report similar results, indicating a neutral impact of this risk factor to explain green and black portfolios' returns. For black mutual funds, when the *FTSE All-World Mining Index* is used as a *benchmark*, the HML coefficient is negative for both portfolios. However, for the equally-weighted portfolio, the HML value is negative and statistically significant at a 10% level, which shows a higher exposure to growth stocks, being inconsistent with Ibikunle and Steffen (2017) conclusions. At an individual level, at a 5% level of significance, 9 exhibit negative and statistically significant HML coefficients, and 1 funds shows a positive and statistically significant value. This conclusion is slightly different from the unconditional four-factor model results.

The momentum factor (MOM), also shows slightly differences from the unconditional model. When using the *FTSE All-World Index* and the *FTSE4GOOD Global Index* as a *benchmark* the momentum factor shows a neutral influence to explain green portfolios' returns. This is not similar with the unconditional four-factor model, as the equally-weighted portfolio results (using both indices) presented a higher exposure to winner stocks.

In relation to the adjusted coefficient of determination (Adj. R^2). The incorporation of lagged information variables slightly increases the explanatory power in the three panels. This is in line with previous literature, for example, with Cortez et al. (2009).

Concerning Panel A, the Wald test results do not allow the rejection (at a 5% level) of the null hypothesis of conditional alphas being equal to zero for green and black portfolios. At the individual fund level, this conclusion also holds, with 14% of green funds and 14% of black funds rejecting this null hypothesis. Nevertheless, regarding conditional betas the results allow the rejection (at a 5% level) of the null hypothesis

that these coefficients are equal to zero for green and black portfolios. This gives support for time-varying betas. Individually, 48% of green funds and 54% of black funds reject the null hypothesis. Finally, the results from joint time-varying alphas and betas test, allow the rejection of the null hypothesis at 5% level. At the individual level, 48% of green and 64% of black funds support this conclusion. Regarding Panel B and C, the conclusions are very similar. These results support the use of conditional models for green and black funds.

Considering the portfolio differences, there are no statistically significant differences, suggesting that the performance of green funds is not statistically different from the performance of black mutual funds.

5.2.2 Conditional Fama and French (2015) five-factor model

Table 5 reports the estimation results of green and black mutual funds for the conditional five-factor model, using the *FTSE All-World Index*, *FTSE4GOOD Global Index* and *FTSE All-World Mining Index* as market proxies. The results at the individual level, for each fund, are summarised in the table and complete results are presented in appendices 15, 16, 17, and 18.

Results are in general similar to those presented for the unconditional five-factor model and for the conditional four-factor model.

Table 5. Empirical Results for Conditional Fama and French (2015) five-factor model

The table reports regression estimates for equally and value weighted portfolios, considering the period December 2003 to November 2019. The results are obtained by the regression of the conditional Carhart (1997) four-factor model (eq. 4), using three alternative indices: Panel A reports empirical results for green and black mutual funds, using the FTSE All-World Index, Panel B presents estimations concerning only green funds, applying the FTSE4GOOD Global Index and Panel C shows the results for black funds, using the FTSE All-World Mining Index as market proxy. This table also reports the portfolios' difference between green and black funds.
Additionally, it presents the performance estimates (α_p), the conditional alphas coefficients (α_{DY}, α_{TB}), the systematic risk (β_{MKT}), the conditional beta estimates (β_{MKT*DY}, β_{MKT*TB}, β_{SMB*DY}, β_{SMB*TB}, β_{HML*DY}, β_{CMA*DY}, β_{CMA*TB}, β_{RMW*DY} and β_{RMW*TB}), the regression coefficients of size (SMB), book-to-market (HML), investments (CMA) and profitability (RMW) factors and the adjusted coefficient of determination ($Adj.\ R^2$). The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. W1, W2 and W3 correspond to the probability values from the Wald test on the existence of time-varying alphas, time-varying betas and joint time-varying alphas and betas.

Panel A: FTSE All-World Index

	Green Mutual funds (1)				**Black Mutual funds (2)**				**Portfolio Difference (1)- (2)**	
	Equally W.	**Value W.**	**N+**	**N-**	**Equally W.**	**Value W.**	**N+**	**N-**	**Equally W.**	**Value W.**
α_p	-0.0037**	-0.0035**	1[0]	20[11]	-0.0036	-0.0037	7[0]	21[8]	-0.0002	0.0002
α_{DY}	-0.0067	-0.0026	10[1]	11[1]	0.0143	0.0141	21[3]	7[0]	-0.0220	-0.0169
α_{TB}	-0.0004	0.0010	13[1]	8[0]	-0.0104	-0.0085	11[4]	17[2]	0.0100	0.0095
β_{MKT}	1.1557***	1.1621***	21[21]	0[0]	0.9373***	1.0782***	28[28]	0[0]	0.2229*	0.0842
β_{MKT*DY}	0.2776*	0.2108	15[2]	6[1]	1.0356**	1.1051**	24[9]	4[0]	-0.7494	-0.8929*
β_{MKT*TB}	0.0777	-0.0427	10[1]	11[1]	0.7246***	0.6709*	22[12]	6[0]	-0.6392**	-0.7106***
β_{SMB}	0.5122***	0.6218***	20[15]	1[0]	0.8882***	0.8409***	27[20]	1 [0]	-0.3948	-0.2211
β_{SMB*DY}	0.9434***	1.0367***	14[7]	7[1]	1.3910	1.7752	21[0]	7 [0]	-0.4626	-0.7441
β_{SMB*TB}	0.1914	0.2285	11[2]	10[0]	0.5075	0.5541	26[4]	2[0]	-0.3024	-0.3248
β_{HML}	0.1373	0.0875	8[2]	13[1]	0.6005*	0.7331**	22[13]	6[0]	-0.4501	-0.6456**
β_{HML*DY}	-0.0484	0.0313	9[0]	12[2]	-2.9239**	-3.0893***	4[0]	24[15]	2.8962**	3.1361**
β_{HML*TB}	0.7671***	0.8152***	17[5]	4[0]	0.9462	1.0289	22[5]	6[1]	-0.1721	-0.2139
β_{CMA}	-0.2087	-0.1880	14[2]	7[4]	-1.4935***	-1.5376**	6[2]	22[10]	1.2778***	1.3599***
β_{CMA*DY}	0.5406	0.3046	17[2]	4[0]	5.8497***	5.5858***	26[20]	2[0]	-5.3261***	-5.2867***
β_{CMA*TB}	-0.3266	-0.4200	8[1]	13[2]	2.4324**	2.1134	26[12]	2[0]	-2.7876**	-2.5258**
β_{RMW}	0.2157*	0.2539*	13[4]	8[0]	-0.0198	0.0228	14[2]	14[1]	0.2404	0.2399
β_{RMW*DY}	0.6978*	0.8136	11[1]	10[1]	-1.2156	-1.3614	2[0]	26[0]	1.9599	2.2017
β_{RMW*TB}	-0.0679	-0.0741	13[0]	8[0]	1.5283	0.9711	18[3]	10 [0]	-1.6313*	-1.0415
Adj. R^2	0.9215	0.9158	-	-	0.5154	0.5618	-	-	0.1109	0.0942
w1	0.7106	0.8783	-	-	0.2371	0.3749	-	-	0.1515	0.2728
w2	0.0001	0.0017	-	-	0.0001	0.0001	-	-	0.0050	0.0054
w3	0.0000	0.0000	-	-	0.0000	0.0000	-	-	0.0050	0.0057

Table 5 (continued)

Panel B: FTSE4GOOD Global Index					Panel C: FTSE All-World Mining Index				
Green Mutual funds					Black Mutual funds				
	Equally W.	**Value W.**	**N+**	**N-**		**Equally W.**	**Value W.**	**N+**	**N-**
α_p	-0.0037***	-0.0034**	1[0]	20[11]	α_p	-0.0022	-0.0017	2[0]	26[0]
α_{DY}	-0.0087	-0.0050	10[1]	11[1]	α_{DY}	0.0074	0.0036	15[0]	13[0]
α_{TB}	-0.0012	-0.0000	12[1]	9[0]	α_{TB}	-0.0068	-0.0058	6[0]	22[0]
β_{MKT}	1.1160***	1.1179***	21[21]	0 [0]	β_{MKT}	0.7672***	0.8542***	28[28]	0 [0]
β_{MKT*DY}	0.5695***	0.5256***	18[11]	3[1]	β_{MKT*DY}	0.1859	0.2768***	26[3]	2[0]
β_{MKT*TB}	0.1897**	0.0811	17[4]	4[0]	β_{MKT*TB}	0.0737	0.1082*	19[5]	9[1]
β_{SMB}	0.6626***	0.7713***	21[20]	0 [0]	β_{SMB}	0.4947***	0.3702***	20[10]	8[0]
β_{SMB*DY}	1.1031***	1.2078***	17[9]	4[0]	β_{SMB*DY}	0.3592	0.6920	21[0]	7[0]
β_{SMB*TB}	0.2553*	0.2719	10[1]	11[0]	β_{SMB*TB}	-0.4730*	-0.5312***	10[0]	18[4]
β_{HML}	0.1775*	0.1284	8[2]	13[1]	β_{HML}	-0.0412	0.0704	17[12]	11[6]
β_{HML*DY}	-0.6903*	-0.6529*	3[0]	18[3]	β_{HML*DY}	-1.0938**	-1.1505***	5[0]	23[4]
β_{HML*TB}	0.8959***	0.9390***	17[6]	4[0]	β_{HML*TB}	0.0891	-0.1576	15[0]	13[1]
β_{CMA}	-0.3671**	-0.3533**	10[1]	11[5]	β_{CMA}	-0.5393**	-0.5621***	10[0]	18[13]
β_{CMA*DY}	1.2013***	1.0319*	21[7]	0[0]	β_{CMA*DY}	2.8006***	2.7830***	21[12]	7[5]
β_{CMA*TB}	-0.0960	-0.1453	14[1]	7[2]	β_{CMA*TB}	0.6142	0.6652	23[3]	5[0]
β_{RMW}	0.3307**	0.3671**	18[4]	3[0]	β_{RMW}	-0.1074	-0.1066	17[0]	11[2]
β_{RMW*DY}	0.5339	0.6481	12[0]	9[0]	β_{RMW*DY}	-0.3150	-0.3202	16[0]	12[0]
β_{RMW*TB}	-0.0082	-0.0231	12[0]	9[0]	β_{RMW*TB}	0.7769	0.2491	14[7]	14[1]
Adj. R^2	0.9071	0.8999	-	-	**Adj. R^2**	0.8546	0.9275	-	-
w1	0.3508	0.7842	-	-	**w1**	0.1734	0.1645	-	-
w2	0.0000	0.0000	-	-	**w2**	0.0048	0.0000	-	-
w3	0.0000	0.0000	-	-	**w3**	0.0060	0.0000	-	-

Analysing this table, panels A and B report an underperformance of green funds in relation to the market. There is a slightly difference between green funds' performance results in comparison with the conditional four-factor model. When applying the *FTSE4GOOD Global Index,* the results are negative and statistically significant, while in the conditional four factor model, the findings suggested a neutral performance of these funds. Yet, the underperformance of green funds was also reported by several previous studies, for example with Climent and Soriano (2011), Silva and Cortez (2016), and Ibikunle and Steffen (2017). For black mutual funds, the alpha coefficients from Panel A and C also indicate a neutral performance in relation to the market.

Examining the time-varying alpha estimations, there is no evidence that funds' performance change in different economic environments.

With respect to the market factor, the findings are consistent with those from the unconditional five-factor model and the conditional four-factor model, presenting positive and statistically significant coefficients.

For the size (SMB) factor, the results for both green and black mutual funds are positive and statistically significant, which suggest a higher exposure towards small cap stocks.

Regarding the book-to-market (HML) factor, applying the *FTSE All-World Index* as the *benchmark,* green funds' portfolios present positive but not statistically significant HML coefficient, indicating a neutral influence of this factor in explaining the portfolios' returns.

However, for black funds, the equally-weighted portfolio exhibits a positive and statistically significant HML coefficient at a 10% level and the value-weighted portfolio shows a positive and statistically significant HML value at a 5% level. These results suggest that black funds are more exposed to value stocks than to growth stocks. Individually, there is also a positive tendency, with 22 funds presenting positive results and 6 funds showing negatives values. As for the funds with positive results, 13 are statistically significant at a 5% level. These findings are not consistent with the previous results from this dissertation, but they are in line with the conclusions drawn by Ibikunle and Steffen (2017). Besides, following Bauer et al. (2005), value stocks are related to "*chemical, energy and basic industries"*, which are segments typically included in black portfolios.

For green funds, the results are also different from the previous results of this dissertation. Considering Panel B, the green equally-weighted portfolio exhibits a positive and statistically significant HML coefficient at a 10% level, which indicates a higher exposure towards value stocks. Individually, 8 funds present positive coefficients and 13 funds show negative values. Furthermore, most of the green mutual funds present a neutral exposure to the value factor. These results are inconsistent with many previous studies, for example, with Cortez et al. (2012) and Ibikunle and Steffen (2017), whose conclusions supported a higher exposure to growth stocks. However, Silva and Cortez (2016), also reported some exposition to value stocks from European green funds, and also reported that most funds show neutral exposure to the HML factor.

Considering the investment (CMA) factor, there are significant differences, in comparison to the unconditional five-factor model findings. When the *FTSE All-World Index* is used as a *benchmark* green funds' portfolio also report negative but not statistically significant coefficients, indicating a neutral influence of this risk factor to explain portfolios' returns. However, concerning black mutual funds, the CMA coefficient is now negative and statistically significant for both portfolios, indicating that these funds are more exposed to aggressive stocks. The individual analysis shows a negative tendency, with 22 funds presenting negative coefficients and 6 funds with positive values. As for the funds with a negative CMA coefficient, 10 are statistically significant at a 5% level.

Regarding panel B, green mutual funds' portfolios show negative and statistically significant values at a 5% level concluding that green funds are more exposed to aggressive stocks. Regarding Panel C, black funds also show a higher exposure towards aggressive stocks, reporting negative and statistically significant coefficients. At the individual level, 13 funds show negative and statistically significant values at a 5% level.

In relation to the profitability factor (RMW) coefficients, the results lead to the very same conclusions, suggesting that green funds are more oriented towards high profitability stocks and for the black funds the estimates are not statistically significant.

Furthermore, in relation to portfolios differences, there are no statistically significant differences, suggesting a neutral performance between green and black mutual funds.

The explanatory power of the conditional five-factor model is higher than the explanatory power of the unconditional five-factor model. In the three panels, the adjusted R^2 shows a slight increase. Comparing with the conditional Carhart (1997) four-factor model, the five-factor model shows slightly higher values, proving to be better to explain the portfolio's returns of both types of funds.

Concerning the three panels, the Wald test results indicate that the null hypothesis of conditional alphas being equal to zero is not rejected at a 5% level for the green and black equally and value-weighted portfolios. This conclusion does not support the use of conditional models with time-varying alphas. The Wald test results for Panel A indicate that the null hypothesis of conditional betas being equal to zero is rejected at

a 5% level, for both portfolios of the green and black mutual fund. At the individual level, 57% of green funds and 79% of black mutual funds reject this null hypothesis. The results also indicate the rejection (at a 5% level) of the null hypotheses of joint conditional alphas and betas being equal to zero. This means that the results support the use of conditional models with joint time-varying alphas and betas. The individual analysis reports that 71% of green funds and 89% of black funds reject this null hypothesis. Panel B and C results are similar, supporting the same conclusions.

5.3 Expansion and Recession analysis

5.3.1 Carhart (1997) four-factor model

This study also examines mutual funds' performance over different market states. The Center for Economic Policy Research (CEPR) identified two recession periods between December 2003 and November 2019. The first recession period is from April 2008 to June 2009 and the second recession period is from October 2011 to March 2013.

The following table shows the empirical results for the Carhart (1997) four-factor model, including a dummy variable to distinguish between recession and expansion periods. Table 6 reports the estimation results of green and black mutual funds, using the *FTSE All- World Index, FTSE4GOOD Global Index*, and *FTSE All-World Mining Index* as market proxies. The results at the individual level, for each fund, are summarised in the table and detailed results are presented in appendices 19, 20, 21, and 22.

Table 6. Carhart (1997) four-factor model results including a dummy variable for expansion and recession periods

The table reports regression estimates for equally and value weighted portfolios, considering the period December 2003 to November 2019. The results are obtained by the regression of the multifactor model of Carhart (1997) including a dummy variable to distinguish between expansion and recession periods (eq. 5), using three alternative indices: Panel A reports empirical results for green and black mutual funds, using the FTSE All-World Index, Panel B presents estimations concerning only green funds, applying the FTSE4GOOD Global Index and Panel C shows the results for black funds, using the FTSE All-World Mining Index as market proxy. This table also reports the portfolios' difference between green and black funds. D_t refers to the dummy variable that takes a value of 0 in expansion periods and a value of 1 in recession periods. Additionally, it presents the performance estimates in non-crisis periods ($\alpha_{0,p}$), the alpha coefficient for crisis periods ($\alpha_{rec,p} \times D_t$), the beta coefficients β_{MKT}, β_{SMB}, β_{HML}, and β_{MOM}, represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML) and momentum (MOM) factors for non-crisis periods and the coefficients $\beta_{MKT}\times D_t$, $\beta_{SMB}\times D_t$, $\beta_{HML}\times D_t$, and $\beta_{MOM}\times D_t$ represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML) and momentum (MOM) factors for the crisis periods. The $Adj.\ R^2$ refers to the adjusted coefficient of determination.
The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. The analysis contains 13 green mutual funds and 21 black mutual funds. Four green and four black funds were excluded from the sample due to the missing information for recession periods.

Panel A: FTSE All-World Index

	Green Mutual funds (1)				Black mutual funds (2))				Portfolio Difference (1) - (2)	
	Equally W.	**Value W.**	**N+**	**N-**	**Equally W.**	**Value W.**	**N+**	**N-**	**Equally W.**	**Value W.**
$\alpha_{0,p}$	-0.0025**	-0.0026*	2[0]	15[8]	-0.0036	-0.0035	5[0]	19[4]	0.0010	0.0009
$\alpha_{rec,p}\times D_t$	-0.0029	-0.0027	6[0]	11[0]	-0.0086	-0.0093	4[0]	20[0]	0.0057	0.0066
β_{MKT}	1.1349***	1.1327***	17[17]	0[0]	1.0244***	1.1897***	24[23]	0[0]	0.1105	-0.0569
$\beta_{MKT} \times D_t$	0.0184	0.0590	10[1]	7[0]	0.1248	0.0819	18[0]	6[0]	-0.1064	-0.0230
β_{SMB}	0.4114***	0.4877***	16[13]	1[0]	0.8372**	0.7442**	24[15]	0[0]	-0.4258	-0.2565
$\beta_{SMB} \times D_t$	0.4780**	0.4191*	14[5]	3[0]	0.5720	0.7726	16[0]	8[1]	-0.0940	-0.3535
β_{HML}	0.0904	0.0655	9[3]	8[2]	0.3070	0.4158	15[7]	9[0]	-0.2166	-0.3503
$\beta_{HML}\times D_t$	-0.3429**	-0.4761**	6[0]	11[1]	-2.2232***	-2.3996***	0[0]	24[15]	1.8804***	1.9235***
β_{MOM}	0.1357*	0.1599**	13[2]	4[0]	0.2919	0.2968	19[1]	5[1]	-0.1562	-0.1369
$\beta_{MOM} \times D_t$	-0.0464	-0.1368	10[0]	7[1]	-0.2712	-0.3327	3[0]	21[0]	0.2249	0.1959
Adj. R^2	0.9113	0.9046	-	-	0.4445	0.5005	-	-	0.0290	0.0160

Panel B: FTSE4GOOD Global Index

Green Mutual funds

	Equally W.	**Value W.**	**N+**	**N-**
$\alpha_{0,p}$	-0.0020	-0.0021	3[0]	14[9]
$\alpha_{rec,p}\times D_t$	-0.0043	-0.0041	7[0]	10[0]
β_{MKT}	1.0913***	1.0898***	17[17]	0[0]
$\beta_{MKT} \times D_t$	0.0666	0.1045	11[2]	6[0]
β_{SMB}	0.5696***	0.6456***	16[15]	1[0]
$\beta_{SMB} \times D_t$	0.4719*	0.4176	13[6]	4[0]
β_{HML}	0.0860	0.0609	8[1]	9[2]
$\beta_{HML}\times D_t$	-0.6450***	-0.7879***	2[0]	15[8]
β_{MOM}	0.1984***	0.2225***	14[2]	3[0]
$\beta_{MOM} \times D_t$	-0.1114	-0.2034*	8[0]	9[2]
Adj. R^2	0.8876	0.8817	-	-

Panel C: FTSE All-World Mining Index

Black Mutual funds

	Equally W.	**Value W.**	**N+**	**N-**
$\alpha_{0,p}$	-0.0027	-0.0023	2[0]	22[1]
$\alpha_{rec,p}\times D_t$	0.0020	0.0021	17[2]	7[0]
β_{MKT}	0.7818***	0.8761***	24[24]	0[0]
$\beta_{MKT} \times D_t$	0.0349	0.0238	13[4]	11[0]
β_{SMB}	0.5308***	0.4036***	23[7]	1[0]
$\beta_{SMB} \times D_t$	0.3110	0.4870	16[0]	8[2]
β_{HML}	-0.1889	-0.1274	12[3]	12[7]
$\beta_{HML}\times D_t$	-0.3898	-0.3831	6[0]	18[5]
β_{MOM}	-0.0585	-0.0924	9[0]	15[3]
$\beta_{MOM} \times D_t$	0.1037	0.0796	16[1]	8[1]
Adj. R^2	0.8410	0.9164	-	-

Analysing table 6, when the *FTSE All-World Index* is used as a *benchmark*, the alphas of green portfolios are negative and statistically significant (for the equally-weighted portfolio the level of significance is 5%, while for the value-weighted is 10%) suggesting an underperformance of green funds in expansion periods. The individual analysis suggests a negative tendency, with 15 funds showing negative alpha coefficients and 2 funds with positive values. As for the funds with negative alphas 8 are statistically significant at a 5% level. Examining the alpha coefficient associated with the dummy variable, the results are not statistically significant. Note that this coefficient represents the increment (positive or negative) in recession periods. If the results were statistically significant, there would be a difference between the performance in expansion and recession periods. As the results are not statistically significant there is no significant change of performance in expansion *versus* recession periods. With respect to black mutual funds, there is a neutral performance in expansion periods, and there is no significant change of performance in recession periods. These conclusions are consistent with those found by Silva and Cortez (2016) since these authors have clear evidence that European green funds underperform the market in non-crisis periods, but there is no evidence of significant change in performance in recession periods.

Furthermore, the coefficient for the dummy variable associated to the market risk is not significant for both portfolios, indicating that this coefficient does not diverge in expansion and recession periods.

Panel A also shows that, in recession periods, the green equally-weighted portfolio reports a positive and statistically significant size coefficient at a 5% level, while the value-weighted portfolios reports a positive and statistically significant SMB coefficient at a 10% level of significance. As the results are positive and statistically significant, there is a positive and significant change in the size coefficient between recession *versus* expansion periods. Regarding black mutual funds, there is no significant change in size coefficient between good and bad economic conditions.

Regarding the book-to-market factor, when using the *FTSE All-World Index* as a *benchmark,* the coefficients are negative and statistically significant at a 5% level, for both portfolios of green (at a 5% level) and black (at a 1% level) funds , indicating that the HML coefficients of the expansion and recession periods diverge significantly.

Additionally, the results show that green and black funds are highly exposed to growth stocks in bad economic times. The green result is not supported by the individual analysis, as almost all funds present no significant changes between different market states. However, for black funds this result is supported at the individual level, as 15 funds show negative and statistically significant HML coefficients at a 5% level of significance. Yet, regarding panel C, the book-to-market coefficient associated with the dummy variable is not statistically significant, indicating no significant change in this coefficient.

In bad economic conditions, when applying the *FTSE4GOOD Global Index* as a market proxy, the momentum (MOM) factor exhibits little evidence of a significant change between the momentum coefficients of expansion and recession periods. The value-weighted portfolio shows a negative and statistically significant MOM coefficient (at a 10% level of significance), suggesting a higher exposure to past losers' stocks. With respect to black funds, in bad economic conditions, the momentum coefficients do not diverge significantly.

Regarding portfolio difference, the four-factor model results show that, in expansion and recession periods, there is no statistically significant difference between green and black performance.

5.3.2 Fama and French (2015) five-factor model: expansion and recession analysis

The following table shows the empirical results for the Fama and French (2015) five-factor model, including a dummy variable to distinguish between recession and expansion periods. Table 7 reports the estimation results of green and black mutual funds, using the *FTSE All-World Index*, *FTSE4GOOD Global Index*, and *FTSE All-World Mining Index* as market proxies. The results at the individual level, for each fund, are summarised in the table and detailed results are presented in appendices 23, 24, 25, and 26.

Table 7. Fama and French (2015) five-factor model results including a dummy variable for expansion and recession periods

The table reports regression estimates for equally and value weighted portfolios, considering the period December 2003 to November 2019. The results are obtained by the regression of the Fama and French (2015) five-factor model including a dummy variable to distinguish between expansion and recession periods (eq. 6), using three alternative indices: Panel A reports empirical results for green and black mutual funds, using the FTSE All-World Index, Panel B presents estimations concerning only green funds, applying the FTSE4GOOD Global Index and Panel C shows the results for black funds, using the FTSE All-World Mining Index as market proxy. This table also reports the portfolios' difference between green and black funds. D_t refers to the dummy variable that takes a value of 0 in expansion periods and a value of 1 in recession periods. Additionally, it presents the performance estimates in non-crisis periods ($\alpha_{0,p}$), the alpha coefficient for crisis periods ($\alpha_{rec,p} \times D_t$), the beta coefficients β_{MKT}, β_{SMB}, β_{HML}, $\beta_{CMA,}$ and β_{RMW}, represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML)), investment (CMA) and profitability (RMW) factors for non-crisis periods and the coefficients $\beta_{MKT}\times D_t$, $\beta_{SMB}\times D_t$, $\beta_{HML}\times D_{t,}$ $\beta_{CMA}\times D_t$ and $\beta_{RMW}\times D_t$ represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML)), investment (CMA) and profitability (RMW) factors for the crisis periods. The $Adj.\ R^2$ refers to the adjusted coefficient of determination.
The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. The analysis contains 13 green mutual funds and 21 black mutual funds. Four green and four black funds were excluded from the sample due to the missing information for recession periods.

Panel A: FTSE All-World Index

	Green Mutual funds (1)				**Black Mutual funds (2)**				**Portfolio Difference (1) - (2)**	
	Equally W.	Value W.	N+	N-	Equally W.	Value W.	N+	N-	Equally W.	Value W.
$\alpha_{0,p}$	-0.0027*	-0.0026	1[0]	16[7]	-0.0035	-0.0031	3[0]	21[5]	0.0008	0.0005
$\alpha_{rec,p}\times D_t$	-0.0032	-0.0036	4[0]	13[1]	0.0026	0.0018	17[1]	7[0]	-0.0058	-0.0054
β_{MKT}	1.1426***	1.1418***	17[17]	0[0]	0.9897***	1.1512***	24[24]	0[0]	0.1529	-0.0094
$\beta_{MKT} \times D_t$	-0.0248	0.0542	9[0]	8[0]	-0.2608	-0.2988	5[0]	19[3]	0.2359	0.3530
β_{SMB}	0.4686***	0.5537***	16[12]	1[0]	0.8791**	0.7795**	24[19]	0[0]	-0.4105	-0.2258
$\beta_{SMB} \times D_t$	0.3513	0.4051	13[1]	4[0]	-0.1910	0.0948	8[0]	16[2]	0.5423	0.3103
β_{HML}	0.0991	0.0488	7[1]	10[1]	0.5783*	0.6636*	20[11]	4[0]	-0.4792	-0.6147*
$\beta_{HML}\times D_t$	-0.4539*	-0.3121	5[0]	12[1]	-2.6244***	-2.4589***	1[0]	23[16]	2.1705***	2.1468**
β_{CMA}	-0.1177	-0.0981	9[2]	8[2]	-0.9750	-0.9700	7[0]	17[3]	0.8573	0.8719
$\beta_{CMA} \times D_t$	0.1566	0.0548	8[1]	9[0]	-0.1303	-0.3546	10[0]	14[1]	0.2869	0.4094
β_{RMW}	0.2000	0.1914	10[1]	7[0]	0.3380	0.2664	21[1]	3[0]	-0.1381	-0.0750
$\beta_{RMW} \times D_t$	-0.2121	0.2357	8[0]	9[0]	-2.6354**	-2.1352*	0[0]	24[5]	2.4233**	2.3710*
Adj. R^2	0.9085	0.9025	-	-	0.4565	0.5087	-	-	0.0511	0.0376

Panel B: FTSE4GOOD Global Index

	Green Mutual funds			
	Equally W.	**Value W.**	**N+**	**N-**
$\alpha_{0,p}$	-0.0022	-0.0021	2[0]	15[7]
$\alpha_{rec,p}\times D_t$	-0.0034	-0.0037	5[0]	12[0]
β_{MKT}	1.0974***	1.0967***	17[17]	0[0]
$\beta_{MKT} \times D_t$	-0.0211	0.0527	9[0]	8[0]
β_{SMB}	0.6459***	0.7309***	17[16]	0[0]
$\beta_{SMB} \times D_t$	0.2571	0.3147	13[0]	4[0]
β_{HML}	0.1350	0.0846	7[1]	10[0]
$\beta_{HML}\times D_t$	-0.7162**	-0.5876	3[0]	14[5]
β_{CMA}	-0.2637	-0.2440	6[2]	11[2]
$\beta_{CMA} \times D_t$	0.1417	0.0229	7[1]	10[0]
β_{RMW}	0.2980*	0.2895*	14[1]	3[0]
$\beta_{RMW} \times D_t$	-0.4258	0.0087	6[0]	11[2]
Adj. R^2	0.8848	0.8792	-	-

Panel C: FTSE All-World Mining Index

	Black Mutual funds			
	Equally W.	**Value W.**	**N+**	**N-**
$\alpha_{0,p}$	-0.0036	-0.0028	0[0]	24[0]
$\alpha_{rec,p}\times D_t$	0.0012	0.0005	12[1]	12[0]
β_{MKT}	0.7700***	0.8618***	24[24]	0[0]
$\beta_{MKT} \times D_t$	0.1475	0.1573	15[2]	9[1]
β_{SMB}	0.4935***	0.3409**	22[9]	2[0]
$\beta_{SMB} \times D_t$	0.3415	0.6605	15[0]	9[3]
β_{HML}	0.0430	0.0841	14[10]	10[3]
$\beta_{HML}\times D_t$	-1.2311***	-0.8878**	1[0]	23[8]
β_{CMA}	-0.4117	-0.3951*	10[1]	14[9]
$\beta_{CMA} \times D_t$	1.3226*	1.2045*	18[7]	6[1]
β_{RMW}	0.1300	-0.0082	15[2]	9[1]
$\beta_{RMW} \times D_t$	-0.7756	-0.1262	3[0]	21[1]
Adj. R^2	0.8471	0.9192	-	-

Analysing table 7, the results are analogous with those reported in the four-factor model.

Starting with Panel A, the results of the alpha coefficient associated with the dummy variable are not statistically significant, meaning there is no significant change of performance in expansion *versus* recession periods. This result is supported by the individual analysis, as none of the funds show significant changes in performance. Concerning black funds, when applying the conventional or the "black" *benchmark,* the alpha coefficients associated with the dummy variable are not statistically significant, suggesting no significant change of performance in different market states. At the individual fund level, there is a black fund presenting a positive and statistically significant value, meaning that there is a positive increment between the alpha coefficient of this funds in expansion periods and in recession periods.

Regarding the market and the size factors, similar to the reported in the four-factor model there are no significant changes between the coefficients of these risk factors in different economic states for green and black funds.

In relation to the book-to-market factor, the results are in line with the findings of the four-factor model. When using the *FTSE4GOOD Global Index* as a market proxy, the green equally-weighted portfolio reports a statistically significant (at a 5% level) HML coefficient associated with the dummy variable. This finding indicates that the HML coefficient diverges in a significant way between expansion *versus* recession periods. For black mutual funds (panel A and C), there is also a significant change in the book-to-market coefficient between good and bad economic conditions. The results also suggest a higher exposure of green and black towards growth stocks, during recession periods.

Additionally, for green mutual funds, the investment and profitability coefficients associated with the dummy variable are not statistically significant, which suggest that these coefficients do not diverge in expansion *versus* recession periods. Individual analysis also shows that the majority of green funds have no significant CMA and RMW values. Considering black funds, Panel A, reports a positive and statistically significant dummy variable of the profitability factor, which indicates that the black

funds coefficients diverge in expansion and recession periods, and also are more exposed to companies with weak profitability. Concerning Panel C, the dummy coefficients of the investment factor are positive and statistically significant at a 10% level, suggesting a change between the CMA coefficient in different market states. Furthermore, these funds exhibits a higher exposure to conservative stocks.

Regarding portfolio difference, the results show that there are no significant differences between the performance of green and black mutual funds in different market states.

Comparing the adjusted R^2 the five-factor model presents a slightly higher coefficient for black funds, in comparison with the four-factor model, proving to be better to explain black funds returns. However, concerning green funds, the four-factor model proves to be better, as the adjusted R^2 coefficient is slightly higher than in the five-factor model.

6. Conclusion

This dissertation analyses the performance of 21 European green mutual funds and 28 European black mutual funds, with a global investment focus, and domiciled in six European countries. The full period considered is from December 2003 to November 2019. To perform this analysis, the green and black mutual funds were selected examining their investment objectives. Three different indices were used, a conventional index (*FTSE All-World Index),* a socially responsible index (*FTSE4GOOD Global Index),* and a "black" index (*FTSE All-World Mining Index)*. Yet, other *benchmarks* were applied, the *FTSE Environmental Opportunities All-Share Index* for green funds, and the *S&P Global Natural Resources Index* for black funds, presenting similar results.

To evaluate the performance of green and black mutual funds at their individual and aggregate level, the unconditional models of Carhart (1997) four-factor model and the Fama and French (2015) five-factor model were applied. Additionally, the conditional model of Christopherson, Ferson, and Glassman (1998) was also used, considering the *short-term rate* and the *dividend yield* as public information variables. Two alternative models were considered to analyse the funds' performance during expansion and recession periods.

The main findings suggest that there is no significant difference between the performance of green and black funds. Moreover, green funds exhibit an underperformance in relation to the market, while black funds report a neutral performance.

In terms of risk exposure, green mutual funds show higher market betas than black funds. However, considering the portfolio difference, the result is not statistically significant. Furthermore, green funds present higher exposure to the conventional *benchmark* as the coefficient of the adjusted R^2 is slightly higher when using a conventional index. For black funds, attending to the adjusted R^2, the *FTSE All-World Mining Index* proves to be better at explaining the funds returns.

Considering the investment style, both green and black funds are highly oriented towards small cap stocks, however, focusing on the portfolio difference, green funds

show to be less exposed to small cap stocks than black funds. By contrast, the book-to-market, momentum, investment, and profitability factors differences between green and black funds are not statistically significant.

The book-to-market (HML) results show neutral influence of this risk factor to explain green and black funds returns, except in few cases. For green funds, when applying the *FTSE4GOOD Global Index*, the conditional five-factor model reports little evidence of a higher exposure of these funds to value stocks. Regarding black funds, the unconditional and the conditional four-factor model, presented evidence of a higher exposure to growth stocks.

Considering the momentum factor, the findings indicate a neutral influence of this factor to explain green and black returns. However, for green funds the unconditional four-factor model suggests a higher exposure to past winner stocks.

For the investment (CMA) factor the evidence is mixed. Considering green funds, when using the *FTSE All-World Index* as the market proxy, the estimates are not statistically significant, indicating that this factor does not affect the green funds returns. However, when applying the *FTSE4GOOD Global Index,* the results suggest a higher exposure towards aggressive stocks. With respect to black funds, the unconditional model presents no significant values, while the conditional model report that black funds are more exposed to aggressive stocks.

Concerning the profitability (RMW) factor, the main results indicate that green mutual funds are more exposed to companies with robust profitability, while other results indicate that there is no influence of this factor to explain the black funds returns.

The introduction of public information variables led to a slight increase in the explanatory power of the models. This is in line with many previous studies related to performance evaluation. Additionally, the general results of the Wald test do not support the use of conditional models for time-varying alphas. Although, the empirical results do support the use of conditional models for time-varying betas and joint time-varying alphas and betas for green and black mutual funds. Comparing the conditional models, the five-factor model reports a slightly higher adjusted coefficient of determination, proving to be better at explaining the portfolio's returns.

Considering different market states, green and black mutual funds do not present significant changes in performance between expansion *versus* recession periods. The results also suggest that, for green funds, the size and the book-to-market coefficients of the expansion and recession periods diverge significantly. These findings indicate that green funds significantly increase their exposure towards small cap stocks and are also highly exposed to growth stocks in bad economic times. For black funds, there is also evidence of a statistically significant dummy associated with the HML coefficient, showing a higher exposure of black funds to growth stocks, in recession times.

Comparing both models, the four-factor model, including a dummy variable to distinguish between expansion and recession periods, proves to be better to explain green funds returns, as the adjusted R^2 coefficients are higher for this model. For black funds, the five-factor model proves to be better to explain these funds returns, presenting higher adjusted R^2.

This study should be improved in the future, performing a matched-pair analysis between green, black, and conventional funds, taking into account, for example, the investment focus, size, and age of each mutual fund. To perform this new analysis, it should be better to also consider a higher number of countries. Besides, this dissertation has some limitations. The most important limitation is related to the selection of green and black mutual funds, as the selection required the translation of KIID and Prospectus documents from other languages rather than English. For this reason, some translations might have conducted to wrong decisions about the inclusion or exclusion of funds.

In sum, this study findings support the view that green mutual funds' performance is comparable to black mutual funds' performance. This suggests that no investor will obtain higher returns investing in green or black funds.

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Appendices

Appendix 1. List of European green funds

Funds	Fund Name	ISIN CODE	Base Date	Total Net Asset Value (TNA)
F1	Amundi - KBI Aqua (C)	FR0013216207	Dec -16	134.9973M
F2	Capital Planete Aviva Investors France	FR0010921452	Jun-11	65.4789M
F3	Dom Prospective C Dom Finance	FR0011169382	Mar-12	25.0252M
F4	Energies Renouvelables Palatine Asset Management	FR0010244160	Nov-05	9.2925M
F5	Entheca Rarete Societe Generale	FR0010567438	Feb-08	4.2453M
F6	Mansartis Ternativ i	FR0013250990	May-17	3.0802M
F7	Palatine Planete A	FR0010341800	Jul-06	23.3214M
F8	UFF Capital Planhte a Aviva Investors France	FR0010921494	Jun-11	48.1737M
F9	ASN Milieu & Waterfonds 2	NL0000280501	Jul-01	675.7795M
F10	Deka Investment Umweltinvest CF	DE000DK0ECS2	Dec-06	308.51M
F11	DWS Global Water LD	DE000DWS0DT1	Mar-07	166.377M
F12	TBF Smart Power EUR R	DE000A0RHHC8	Feb-10	15.985M
F13	KBC Eco Fund Alternative Energy Cap	BE0175280016	Oct-00	28.1936M
F14	KBC Eco Fund Climate Change Cap	BE0946844272	Feb-07	28.2039M
F15	KBC Eco Fund CSOB Water Capital	BE0947250453	Aug-07	57.1773M
F16	KBC Eco Fund Water Cap	BE0175479063	Dec-00	554.238M
F17	Erste WWF Stock Environment A	AT0000705660	Jul-01	48.3079M
F18	S Generation	AT0000A0JGB6	Jul-10	20.9865M
F19	EQ Blue lanet 1 K	FI0008806112	May-02	54.2043M
F20	OP-Clean Water A	FI4000048442	Nov-12	90.7968M
F21	Op-Vahahiilinen Maailma A	FI4000148226	Apr-15	152.0374M

Appendix 2. List of European black mutual funds

Fund	Fund Name	ISIN Code	Base Date	Total Net Asset Value (TNA)
F1	Amundi Actions Minergior P (C)	FR0010478768	Jul-07	79.68M
F2	Amundi Actions Ressources Naturelles P C	FR0012336709	May-15	0.002M
F3	Amundi France LCL Actions or Monde	FR0007374145	Jan-96	19.03M
F4	AXA or Et Matieres Premieres D Eur	FR0010011189	Aug-96	44.89M
F5	CM-CIC Global Gold C	FR0007390174	Jan-96	252.52M
F6	CM-CIC Global Resources C	FR0011274976	Aug-12	17.79M
F7	Edmond De Rothschild Goldsphere A	FR0010657890	Oct-08	6.07M
F8	Energy Value CM CIC Securities	FR0010591990	May-08	0.59M
F9	Etoile Matieres Premieres (C)	FR0013210887	Jan-92	17.26M
F10	FDC Ressources Naturelles	FR0012860526	Aug-15	11.14M
F11	Federal Multi or Et Matieres Federale Finance Gestion	FR0000978868	Jan-96	16.85M
F12	Global Gold and Precious R	FR0007047527	Jul-00	6.07M
F13	R-CO Thematic Gold Mining C Eur	FR0007001581	Jun-96	96.28M
F14	SG Actions or (C)	FR0000424319	Jul-96	50.43M
F15	Societe Generale Actions Matieres Premieres C Asset Management	FR0000423527	Jul-96	22.19M
F16	Strat Indice or(C) Legal & General AM	FR0000983579	Jan-96	11.97M
F17	Tocqueville Gold P Tocqueville Finance SA	FR0010649772	Oct-08	63.70M
F18	Allevia Fund Eur dead - liquidated	DE000A1JBY29	Feb-13	1.81M
F19	DIT Rohstoffonds	DE0008475096	Jul-83	313.44M
F20	DWS Global Natural Resources Equity Typ O	DE0008474123	Jan-86	45.89M
F21	Universal Investment Earth Gold Fund UI	DE000A0Q2SD8	Jul-08	61.71M
F22	Universal Investment Tiberius Exploration Fund UI	DE000A0J3UF6	Oct-06	13.39M
F23	KNC Equity Fund Oil cap	BE0174962713	Oct-00	25.13M
F24	Amundi Gold Stock A	AT0000857040	May-85	36.38M
F25	C-quadrat Gold & Resources Fund R T	AT0000A07HE7	Oct-07	2.55M
F26	DSC Equity Fund - Energy (A)	AT0000A0XMK6	Dec-12	0.53M
F27	Raiffeisen Kapitalanlagegesellschaft Gesellschaft Energie Aktienfonds A	AT0000688668	Feb-02	10.15M
F28	Schoellerbank Global Resources A	AT0000A0GTZ4	Feb-10	3.03M

Appendix 3. Individual performance results of green mutual funds using the unconditional four- factor model (FTSE All-World Index)

The table reports individual estimates of European green mutual funds, considering the period December 2003 to November 2019. The results are obtained by the regression of the unconditional four-factor model (eq. 1), using FTSE All-World Index.
The performance estimates (α_p), the systematic risk (β_{MKT}), the adjusted coefficient of determination ($Adj.\ R^2$) and the regression coefficients of size (SMB), book-to-market (HML) and momentum (MOM) factors are presented. The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994).

Panel A: FTSE All-World Index						
	α_p	β_{MKT}	β_{SMB}	β_{HML}	β_{MOM}	Adj. R^2
F1	0.0016	1.0361***	0.6131***	-0.0813	-0.2656**	0.8925
F2	-0.0040***	1.0267***	0.3948***	-0.2366***	0.0547	0.8991
F3	-0.0057**	1.0949***	0.5255***	0.3279**	-0.1793	0.7838
F4	-0.0054***	1.0872***	0.3470**	0.2136*	0.0325	0.7824
F5	-0.0052***	0.9162***	0.1484	-0.0392	0.0907	0.8043
F6	-0.0030	1.0681***	0.2295	-0.1538	-0.0870	0.8821
F7	-0.0022	0.9906***	-0.0446	-0.0212	0.0414	0.8240
F8	-0.0051***	1.0426***	0.3378***	-0.1657	0.0391	0.8443
F9	-0.0002	1.0291***	0.8365***	-0.1459*	0.0504	0.8645
F10	-0.0042**	1.3212***	0.5915***	-0.3433***	-0.0276	0.8949
F11	-0.0059***	1.1674***	0.3917***	-0.2216**	0.0104	0.8772
F12	-0.0075***	1.3107***	0.9057***	0.2759*	-0.0721	0.7946
F13	-0.0062**	1.3832***	0.7825***	-0.0961	0.1010	0.7577
F14	-0.0050***	1.1704***	0.5265***	-0.0309	0.1057*	0.8930
F15	-0.0029	1.2315***	0.5797***	0.1882	0.0998	0.8339
F16	0.0008	1.0064***	0.4644***	-0.0273	0.0057	0.8950
F17	-0.0028	1.1518***	0.7628***	-0.2254*	0.1891***	0.7889
F18	-0.0064*	1.3476***	0.9681***	0.0132	-0.1820	0.7204
F19	-0.0009	1.0437***	0.1043	-0.0686	0.1666**	0.7357
F20	-0.0011	1.0120***	0.4054***	0.0142	-0.1712	0.7828
F21	-0.0025***	0.9763***	0.1396*	-0.0692	-0.0318	0.9631

Appendix 4. Individual performance results of black mutual funds using the unconditional four-factor model (FTSE All-World Index)

The table reports individual estimates of European black mutual funds, considering the period December 2003 to November 2019. The results are obtained by the regression of the unconditional four-factor model (eq.1), using FTSE All-World Index.
The performance estimates (α_p), the systematic risk (β_{MKT}), the adjusted coefficient of determination ($Adj.\ R^2$) and the regression coefficients of size (SMB), book-to-market (HML) and momentum (MOM) factors are presented. The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994).

Panel A: FTSE All-World Index						
	α_p	β_{MKT}	β_{SMB}	β_{HML}	β_{MOM}	Adj. R^2
F1	-0.0059	1.0437***	0.6907**	-0.0587	0.1177	0.4420
F2	-0.0030	1.1850***	0.5819**	0.7609***	0.0375	0.7773
F3	-0.0028	0.7861***	1.3871***	-0.6593	0.1644	0.1350
F4	-0.0034	1.2472***	0.4340*	0.2293	0.1965	0.5427
F5	-0.0029	0.8427***	1.4881***	-0.5078	0.2042	0.1534
F6	-0.0077**	1.0687***	0.4279*	0.6637***	-0.1566	0.6545
F7	-0.0034	0.5372**	1.2513**	-0.6196	-0.1634	0.0614
F8	-0.0136***	1.2617***	0.9071***	0.2953	-0.1754	0.6502
F9	-0.0050	1.2331***	0.8128***	-0.0429	0.2116*	0.5386
F10	-0.0052	1.2377***	0.3622	0.6017***	0.1056	0.7928
F11	-0.0063*	1.1852***	0.8269***	-0.0844	0.1996	0.5152
F12	-0.0043	0.9338***	1.8153***	-0.5994	0.1608	0.1959
F13	-0.0046	1.1261***	0.6156***	0.0560	0.2374**	0.5414
F14	-0.0032	0.7615***	1.4641***	-0.6167	0.1338	0.1362
F15	-0.0055	1.2095***	0.8198***	0.0173	0.1903	0.5597
F16	-0.0013	0.7422***	1.1366**	-0.5633	0.0299	0.1140
F17	0.0017	0.5615**	1.3623**	-0.6627	-0.0944	0.0597
F18	-0.0200***	1.4981***	1.1805**	0.9185**	0.2023	0.4534
F19	-0.0060	1.5173***	0.9119***	0.1237	0.0186	0.5708
F20	-0.0072**	1.3848***	0.5814**	-0.1606	0.0343	0.6432
F21	0.0001	0.8749***	2.2431***	-1.0758*	-0.3230	0.1843
F22	-0.0090	1.4753***	2.3096***	-0.5211	-0.0432	0.5258
F23	-0.0043	1.0907***	0.2593	0.5044***	0.2223**	0.6178
F24	-0.0015	0.7878***	1.3809***	-0.5913	0.0178	0.1310
F25	-0.0017	0.5451***	1.1080**	-0.3543	-0.0611	0.1015
F26	-0.0066**	1.1560***	0.3558	0.6507***	-0.1776	0.6859
F27	-0.0062**	1.2713***	0.5237**	0.3556	0.1863*	0.6455
F28	-0.0092**	1.1439***	0.8600***	-0.1528	-0.4175***	0.6351

Appendix 5. Individual performance results of green mutual funds using the unconditional four-factor model (FTSE4GOOD Global Index)

The table reports individual estimates of European green mutual funds, considering the period December 2003 to November 2019.The results are obtained by the regression of the unconditional four-factor model (eq.1), using FTSE4GOOD Global Index.
The performance estimates (α_p), the systematic risk (β_{MKT}), the adjusted coefficient of determination ($Adj.\ R^2$) and the regression coefficients of size (SMB), book-to-market (HML) and momentum (MOM) factors are presented. The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994).

Panel B: FTSE4GOOD Global Index						
	α_p	β_{MKT}	β_{SMB}	β_{HML}	β_{MOM}	Adj. R^2
F1	0.0008	1.0616***	0.6901***	-0.0503	-0.2335*	0.8840
F2	-0.0047***	1.0188***	0.5133***	-0.2738***	0.0489	0.8822
F3	-0.0060**	1.0416***	0.6426***	0.3047*	-0.1965	0.7386
F4	-0.0053**	1.0741***	0.5160***	0.1195	0.0474	0.7767
F5	-0.0057***	0.9130***	0.3117***	-0.1303	0.0973	0.8114
F6	-0.0038	1.0904***	0.3071	-0.1336	-0.0597	0.8695
F7	-0.0022	0.9874***	0.1182	-0.1109	0.0592	0.8299
F8	-0.0059***	1.0458***	0.4614***	-0.1998*	0.0396	0.8451
F9	0.0002	1.0069***	1.0014***	-0.2171**	0.0668	0.8399
F10	-0.0040*	1.2924***	0.8049***	-0.4663***	-0.0187	0.8723
F11	-0.0058***	1.1391***	0.5790***	-0.3316**	0.0161	0.8511
F12	-0.0079***	1.2818***	1.1255***	0.2034	-0.0748	0.7897
F13	-0.0056*	1.3455***	1.0046***	-0.1907	0.1194	0.7276
F14	-0.0048**	1.1399***	0.7146***	-0.1398	0.1110*	0.8625
F15	-0.0030	1.2105***	0.7835***	0.0693	0.1088	0.8199
F16	0.0012	0.9841***	0.6256***	-0.0968	0.0214	0.8679
F17	-0.0024	1.1250***	0.9475***	-0.3048**	0.2065***	0.7624
F18	-0.0069**	1.3232***	1.1775***	-0.0573	-0.1830	0.7132
F19	-0.0003	1.0043***	0.2726*	-0.1386	0.1755**	0.6890
F20	-0.0014	0.9800***	0.5103***	0.0007	-0.1873	0.7472
F21	-0.0029**	0.9804***	0.2345***	-0.0414	-0.0088	0.9391

Appendix 6. Individual performance results of black mutual funds using the unconditional four-factor model (FTSE All-World Mining Index)

The table reports individual estimates of European black mutual funds, considering the period December 2003 to November 2019.The results are obtained by the regression of the unconditional four-factor model (eq.1), using FTSE All-World Mining Index.
The performance estimates (α_p), the systematic risk (β_{MKT}), the adjusted coefficient of determination ($Adj.\ R^2$) and the regression coefficients of size (SMB), book-to-market (HML) and momentum (MOM) factors are presented. The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994).

Panel C: FTSE All-World Mining Index						
	α_p	β_{MKT}	β_{SMB}	β_{HML}	β_{MOM}	Adj. R^2
F1	-0.0022	0.7513***	0.2772	0.0392	0.0560	0.8246
F2	-0.0005	0.3594***	0.1370	-0.2053	-0.7345***	0.5326
F3	-0.0045	0.9082***	0.7417**	-0.7783**	0.1852	0.5827
F4	-0.0008	0.8336***	-0.0405	0.1488**	-0.0098	0.9610
F5	-0.0043	0.9247***	0.8405**	-0.6266**	0.2072	0.6043
F6	-0.0003	0.4857***	-0.0194	0.1686	-0.3270**	0.7267
F7	-0.0052	0.9577***	0.8656**	-0.7942**	0.2281	0.5500
F8	-0.0059	0.6285***	0.4379	0.3709	-0.4241***	0.6059
F9	-0.0017	0.7458***	0.4146**	-0.1086	-0.0231	0.7827
F10	-0.0017	0.3528***	0.1232	-0.3210	-0.7257***	0.4856
F11	-0.0038**	0.7889***	0.3789***	-0.1604	0.0023	0.8957
F12	-0.0051	0.9395***	1.1747***	-0.7159**	0.1306	0.6159
F13	-0.0014	0.6618***	0.2694*	-0.0006	0.0154	0.7505
F14	-0.0048	0.8749***	0.8433**	-0.7311**	0.1521	0.5600
F15	-0.0019	0.7034***	0.4546***	-0.0422	-0.0510	0.7532
F16	-0.0029	0.8532***	0.5310	-0.6748**	0.0479	0.5191
F17	-0.0002	1.0078***	0.9574**	-0.8474**	0.3193*	0.5649
F18	-0.0094	0.3445***	0.7271	0.2144	-0.3466	0.1696
F19	-0.0025*	0.9789***	0.3665**	0.0320	-0.2462***	0.9136
F20	-0.0028	0.7584***	0.2058	-0.2203	-0.2605***	0.7748
F21	0.0041	1.1038***	1.5358***	-1.0154***	0.0828	0.6243
F22	-0.0044	0.9908***	1.7382***	-0.4068*	-0.1863	0.7917
F23	-0.0000	0.5040***	0.0478	0.4740**	-0.0467	0.5474
F24	-0.0032	0.9097***	0.7345**	-0.7105**	0.0384	0.5614
F25	0.0001	0.7057***	0.5940	-0.2758	0.1399	0.4727
F26	0.0022	0.3311***	-0.0142	0.1703	-0.5100**	0.3987
F27	-0.0011	0.5747***	0.2889	0.3225	-0.1323	0.5506
F28	-0.0021	0.6582***	0.2090	-0.3034*	-0.3416***	0.7585

Appendix 7. Individual performance results of green mutual funds using the unconditional five-factor model (FTSE All-World Index)

The table reports individual estimates of European green mutual funds, considering the period December 2003 to November 2019.The results are obtained by the regression of the unconditional five-factor model (eq. 2), using FTSE All-World Index.
The performance estimates (α_p), the systematic risk (β_{MKT}), the adjusted coefficient of determination ($Adj.\ R^2$) and the regression coefficients of size (SMB), book-to-market (HML), investment (CMA) and profitability (RMW) factors are presented. The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994).

Panel A: FTSE All-World Index							
	α_p	β_{MKT}	β_{SMB}	β_{HML}	β_{CMA}	β_{RMW}	Adj. R^2
F1	0.0004	1.1296***	0.7059***	0.1476	0.1993	0.4628	0.8776
F2	-0.0041***	1.0267***	0.4276***	-0.2458**	0.0042	0.1079	0.8976
F3	-0.0071***	1.1655***	0.5681***	0.3924*	0.2335	0.0596	0.7768
F4	-0.0047**	1.0460***	0.3066**	0.2506	-0.1920	-0.0771	0.7819
F5	-0.0050***	0.9121***	0.1271	-0.2239	0.1882	-0.1304	0.8019
F6	-0.0036	1.1171***	0.3321	-0.0860	0.2111	0.4157	0.8805
F7	-0.0029	1.0299***	0.0087	-0.1528	0.2880*	0.0939	0.8257
F8	-0.0053***	1.0483***	0.3763***	-0.1640	0.0151	0.1204	0.8427
F9	-0.0012	1.0598***	0.9027***	-0.1672	0.1618	0.2977*	0.8661
F10	-0.0036**	1.2603***	0.5425***	-0.0842	-0.4726**	0.0901	0.8998
F11	-0.0061***	1.1534***	0.3943***	-0.1410	-0.1176	0.1198	0.8772
F12	-0.0065**	1.2814***	0.7722***	0.0724	0.2175	-0.5490*	0.7984
F13	-0.0053*	1.2929***	0.7401***	0.0734	-0.5089**	0.0801	0.7602
F14	-0.0052***	1.1617***	0.5466***	-0.0957	0.0606	0.1423	0.8896
F15	-0.0034	1.2732***	0.6215***	-0.0886	0.4361*	-0.0185	0.8355
F16	0.0005	1.0153***	0.4797***	-0.0285	0.0401	0.0719	0.8946
F17	-0.0013	1.0778***	0.7502***	-0.2923**	-0.1931	-0.0851	0.7791
F18	-0.0043	1.2584***	0.6585**	0.1434	-0.6524*	-0.8246**	0.7340
F19	-0.0027	1.0116***	0.1950	0.1975	-0.3387	0.8649***	0.7566
F20	-0.0018	1.0564***	0.3952**	0.0712	0.1576	-0.0506	0.7735
F21	-0.0032***	0.9881***	0.2118***	0.1055	-0.1114	0.3188***	0.9672

Appendix 8. Individual performance results of black mutual funds using the unconditional five-factor model (FTSE All-World Index)

The table reports individual estimates of European black mutual funds, considering the period December 2003 to November 2019. The results are obtained by the regression of the unconditional five-factor model (eq. 2), using FTSE All-World Index.
The performance estimates (α_p), the systematic risk (β_{MKT}), the adjusted coefficient of determination ($Adj.\ R^2$) and the regression coefficients of size (SMB), book-to-market (HML) investment (CMA) and profitability (RMW) factors are presented. The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994).

Panel A: FTSE All-World Index							
	α_p	β_{MKT}	β_{SMB}	β_{HML}	β_{CMA}	β_{RMW}	Adj. R^2
F1	-0.0054	0.9903***	0.6629*	-0.0498	-0.1785	0.0624	0.4364
F2	-0.0013	1.2656***	0.5208**	-0.0534	1.1571***	-0.9041**	0.8143
F3	-0.0001	0.5887***	1.2539**	-0.3496	-1.0704	-0.1215	0.1385
F4	-0.0023	1.0993***	0.3860	0.5338*	-0.8503	0.2812	0.5501
F5	-0.0001	0.6635***	1.3795***	-0.3273	-0.8616	-0.1764	0.1521
F6	-0.0089***	1.1389***	0.4966*	0.6761**	0.3568	0.1178	0.6501
F7	-0.0033	0.5553**	1.2428*	-0.4824	-0.1687	-0.1233	0.0518
F8	-0.0109**	1.1781***	0.7274**	0.5657*	-0.6722*	-0.5188	0.6526
F9	-0.0040	1.0666***	0.7604***	0.3386	-0.9962*	0.3759	0.5517
F10	-0.0042	1.2986***	0.3199	-0.0787	0.9423**	-0.5695	0.8128
F11	-0.0045	1.0051***	0.7407***	0.2494	-1.0116*	0.1455	0.5267
F12	-0.0016	0.7597***	1.6959***	-0.3872	-0.8820	-0.1976	0.1962
F13	-0.0024	0.9463***	0.5351**	0.3008	-0.9152*	0.0591	0.5472
F14	-0.0010	0.6127***	1.3643**	-0.4106	-0.7784	-0.1246	0.1356
F15	-0.0037	1.0060***	0.7170***	0.4726	-1.2262**	0.2375	0.5835
F16	-0.0005	0.6577***	1.0720**	-0.3474	-0.5480	0.0167	0.1121
F17	0.0012	0.6235**	1.4138*	-0.7585	0.3693	-0.0489	0.0528
F18	-0.0199***	1.5889***	1.3826***	0.2724	1.2899	0.0620	0.4610
F19	-0.0043	1.3158***	0.7429**	0.7164**	-1.3953***	0.0607	0.5925
x20	-0.0041	1.1464***	0.3608	0.3815	-1.4970***	-0.2472	0.6785
F21	0.0014	0.8620***	2.1729***	-0.7036	-0.5527	-0.2871	0.1742
F22	-0.0045	1.1953***	1.9919***	0.1600	-1.7353***	-0.4253	0.5510
F23	-0.0063**	1.0784***	0.3884**	0.6589***	-0.1354	0.9060***	0.6240
F24	0.0012	0.6254***	1.2134**	-0.3050	-0.9429	-0.3691	0.1342
F25	-0.0034	0.6353***	1.2177**	-0.4314	0.4133	0.2057	0.0972
F26	-0.0083**	1.2432***	0.4923*	0.7489***	0.3672	0.3565	0.6845
F27	-0.0066*	1.2099***	0.5670***	0.5222**	-0.3621	0.5084	0.6457
F28	-0.0121***	1.2146***	0.8939***	0.3088	-0.2607	0.3477	0.6108

Appendix 9. Individual performance results of green mutual funds using the unconditional five-factor model (FTSE4GOOD Global Index)

The table reports individual estimates of European green mutual funds, considering the period December 2003 to November 2019.The results are obtained by the regression of the unconditional five-factor model (eq. 2), using FTSE4GOOD Global Index.
The performance estimates (α_p), the systematic risk (β_{MKT}), the adjusted coefficient of determination ($Adj.\ R^2$) and the regression coefficients of size (SMB), book-to-market (HML) investment (CMA) and profitability (RMW) factors are presented. The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994).

Panel B: FTSE4GOOD Global Index							
	α_p	β_{MKT}	β_{SMB}	β_{HML}	β_{CMA}	β_{RMW}	Adj. R^2
F1	-0.0001	1.1346***	0.7483***	0.2065	0.0312	0.3490	0.8699
F2	-0.0050***	1.0319***	0.5788***	-0.2495**	0.0057	0.2069	0.8819
F3	-0.0078***	1.1238***	0.7314***	0.4438*	0.1878	0.2024	0.7306
F4	-0.0046**	1.0180***	0.4629***	0.2242	-0.3083	0.0014	0.7777
F5	-0.0056***	0.9040***	0.3007**	-0.2713*	0.1399	-0.0435	0.8071
F6	-0.0042	1.1195***	0.3801	-0.0314	0.0621	0.3369	0.8663
F7	-0.0029	1.0118***	0.1748	-0.1900	0.1943	0.1821	0.8297
F8	-0.0064***	1.0681***	0.5444***	-0.1702	0.0370	0.2452	0.8453
F9	-0.0008	1.0154***	1.0582***	-0.1652	0.0000	0.3604*	0.8417
F10	-0.0034*	1.2126***	0.7297***	-0.1144	-0.6348***	0.1573	0.8824
F11	-0.0058***	1.1043***	0.5613***	-0.1661	-0.2757	0.1714	0.8534
F12	-0.0072***	1.2601***	1.0158***	0.0498	0.1864	-0.4328	0.7910
F13	-0.0047	1.2294***	0.9254***	0.0829	-0.7244***	0.1431	0.7356
F14	-0.0049**	1.1068***	0.7120***	-0.1148	-0.1108	0.1884	0.8594
F15	-0.0034	1.2288***	0.8199***	-0.1282	0.2865	0.0501	0.8181
F16	0.0009	0.9720***	0.6283***	-0.0259	-0.1166	0.1307	0.8685
F17	-0.0007	1.0260***	0.9052***	-0.2851	-0.3705	-0.0310	0.8594
F18	-0.0051	1.2443***	0.8917***	0.1294	-0.6772*	-0.6984*	0.7236
F19	-0.0021	0.9519***	0.3351**	0.2125	-0.5266**	0.8998***	0.7192
F20	-0.0025	1.0330***	0.5376***	0.1083	0.1462	0.0661	0.7361
F21	-0.0037***	1.0012***	0.3355***	0.0878	-0.0148	0.3652**	0.9449

Appendix 10. Individual performance results of green mutual funds using the unconditional five-factor model (FTSE All-World Mining Index)

The table reports individual estimates of European green mutual funds, considering the period December 2003 to November 2019. The results are obtained by the regression of the unconditional five-factor model (eq. 2), using FTSE All-World Mining Index.
The performance estimates (α_p), the systematic risk (β_{MKT}), the adjusted coefficient of determination ($Adj.\ R^2$) and the regression coefficients of size (SMB), book-to-market (HML) investment (CMA) and profitability (RMW) factors are presented. The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994).

Panel C: FTSE All-World Mining Index							
	α_p	β_{MKT}	β_{SMB}	β_{HML}	β_{CMA}	β_{RMW}	Adj. R^2
F1	-0.0029	0.7684***	0.3286*	-0.0642	0.2635	0.1640	0.8247
F2	0.0001	0.3793***	-0.2047	0.8574*	-1.5517***	-0.5818	0.5260
F3	-0.0068	0.9928***	0.9586***	-1.2515***	1.2514*	0.5633	0.5944
F4	-0.0009	0.8263***	-0.0478	0.2221***	-0.1294	0.0514	0.9611
F5	-0.0062	1.0154***	1.0585***	-1.2055***	1.3910**	0.4434	0.6181
F6	-0.0013	0.4924***	-0.1752	0.7352***	-0.8623**	-0.0792	0.7271
F7	-0.0083	0.9924***	1.1219**	-0.9348**	0.8062	1.0746	0.5580
F8	-0.0012	0.5542***	0.1071	0.9101***	-1.3933***	-1.1566**	0.6272
F9	-0.0013	0.7041***	0.3507*	0.1666	-0.6403***	0.0095	0.7895
F10	-0.0028	0.3866***	-0.1367	1.0409**	-1.8818***	-0.0169	0.4923
F11	-0.0033*	0.7670***	0.3428***	-0.0509	-0.3120*	-0.0477	0.8971
F12	-0.0066	1.0181***	1.3450***	-1.1997***	1.1888*	0.2999	0.6258
F13	0.0002	0.6127***	0.1730	0.1642	-0.6416	-0.2835	0.7601
F14	-0.0071	0.9715***	1.0640***	-1.2668***	1.4208**	0.4975	0.5770
F15	-0.0008	0.6372***	0.3337*	0.3464	-0.9851**	-0.1476	0.7717
F16	-0.0060	0.9643***	0.7587**	-1.1616***	1.5366**	0.5692	0.5417
F17	-0.0037	1.0555***	1.2663***	-1.2164***	1.3557**	1.1820*	0.5818
F18	-0.0099	0.3487***	0.4975	0.7409	-0.8879	-0.3288	0.1624
F19	-0.0019	0.9390***	0.2295	0.4103**	-0.7085***	-0.2879	0.9131
F20	0.0001	0.6601***	-0.0684	0.3258*	-1.4545***	-0.7829***	0.8072
F21	0.0003	1.1951***	1.8528***	-1.2884***	1.2026**	0.9116	0.6369
F22	-0.0020	0.9139***	1.5540***	0.1056	-1.1978***	-0.4197	0.8036
F23	-0.0002	0.4667***	0.0023	0.8125***	-0.6378**	0.1757	0.5574
F24	-0.0052	1.0030***	0.9056**	-1.1942***	1.3419***	0.2825	0.5762
F25	-0.0039	0.8170***	0.8977**	-0.8391**	1.6236***	0.6842	0.5134
F26	0.0006	0.3453***	-0.2046	0.9953**	-1.1078*	-0.0185	0.3820
F27	0.0004	0.5102***	0.1354	0.7125***	-0.9730***	-0.3306	0.5664
F28	-0.0028	0.6671***	0.0938	0.1791	-0.7703**	-0.0864	0.7519

Appendix 11. Individual performance results of green mutual funds using the conditional four-factor model (FTSE All-World Index)

The table reports individual estimates of European green mutual funds, considering the period December 2003 to November 2019.The results are obtained by the regression of the conditional four-factor model (eq.3), using FTSE All-World Index. Additionally, it presents the performance estimates (α_p), the conditional alphas coefficients (α_{DY}, α_{TB}), the systematic risk (β_{MKT}), the conditional beta estimates (β_{MKT*DY}, β_{MKT*TB}, β_{SMB*DY}, β_{SMB*TB}, β_{HML*DY}, β_{MOM*DY} and β_{MOM*TB}), the regression coefficients of size (SMB), book-to-market (HML) and momentum (MOM) factors and the adjusted coefficient of determination ($Adj.\ R2$). The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. w1, w2 and w3 correspond to the probability values from the Wald test on the existence of time-varying alphas, time-varying betas and joint time-varying alphas and betas.

Panel A: FTSE All-World Index

	α_p	α_{DY}	α_{TB}	β_{MKT}	β_{MKT*DY}	β_{MKT*TB}	β_{SMB}	β_{SMB*DY}	β_{SMB*TB}	β_{HML}	β_{HML*DY}	β_{HML*TB}	β_{MOM}	β_{MOM*DY}	β_{MOM*TB}	Adj. R^2	w1	w2	w3
F1	0.0111**	0.1064**	-0.0186	1.1428***	-0.3359	0.1942	1.2990**	-3.6426	-0.7118	0.4005	5.4455*	-1.2378*	0.3518	2.8593	-1.7512*	0.9097	0.0259	0.1644	0.1865
F2	-0.0041***	-0.0033	0.0020	1.0445***	-0.0575	-0.0231	0.3686***	0.3283	-0.0140	-0.2404**	1.1629	0.0061	0.0447	-0.0761	-0.0668	0.8931	0.9144	0.8938	0.9134
F3	-0.0067**	0.0201	0.0257**	1.0967***	0.4024	0.0438	0.5542***	3.4920*	0.5283	0.4845***	2.8819	0.2010	-0.1120	0.1630	0.1955	0.7908	0.0375	0.5703	0.2501
F4	-0.0038*	0.0064	-0.0015	1.0847***	0.2869	0.0551	0.4066***	1.1863**	0.1621	0.2825**	0.1775	0.2042	-0.0342	0.2689	-0.1369	0.7867	0.6376	0.2034	0.2189
F5	-0.0045***	0.0110*	-0.0002	0.9704***	-0.0168	0.0420	0.1521	0.1623	-0.3586**	-0.0202	0.5343*	0.1793	0.0478	0.4229***	0.0922	0.8076	0.1045	0.0009	0.0001
F6	-0.0053	0.0136	-0.0013	1.1688***	0.7003	-0.5181	-0.6755	-2.7442	2.3612*	0.0264	-4.9280	0.0026	0.0467	0.5411	0.4457	0.8990	0.9543	0.3113	0.2624
F7	-0.0023	0.0076	-0.0028	1.0365***	-0.1311	-0.0110	-0.0587	0.1265	-0.3222	-0.0769	0.2246	-0.2480	-0.0208	0.2468	-0.0252	0.8242	0.2947	0.3332	0.4279
F8	-0.0053***	0.0138	0.0028	1.0937***	-0.2269	-0.1257	0.2854**	0.6383	0.3838	-0.1191	2.6214	-0.1379	0.0516	-0.3400	-0.0152	0.8493	0.5445	0.0022	0.0032
F9	-0.0000	0.0072	-0.0003	1.0633***	-0.0710	0.0103	0.8650***	0.6069*	-0.0749	-0.1012	0.2576	0.2914	0.0094	0.1037	-0.0472	0.8698	0.4308	0.0886	0.0689
F10	-0.0026	0.0035	0.0005	1.2577***	0.0391	-0.1686**	0.5981***	0.7831	0.1202	-0.2509***	0.0349	0.3312	-0.0530	-0.0350	-0.1524	0.9004	0.9233	0.0005	0.0000
F11	0.0111***	0.1064***	-0.0186	1.1428***	-0.3359	0.1942	1.2990***	-3.6426	-0.7118	0.4005***	5.4455***	-1.2378***	0.3518	2.8593*	-1.7512***	0.8830	0.2414	0.0000	0.0000
F12	-0.0100***	0.0004	0.0244*	1.2850***	0.7624**	-0.8475**	0.7789***	0.5748	1.8881*	0.5172***	1.1993	-0.4783	0.0272	-1.4542**	0.4499	0.8196	0.1722	0.0066	0.0086
F13	-0.0058**	0.0066	-0.0020	1.3315***	0.4139	0.0242	0.7829***	1.7953**	0.6887**	0.0925	-0.2448	1.2041***	0.1105	0.1827	0.0901	0.7887	0.6109	0.0040	0.0000
F14	-0.0041**	-0.0036	-0.0024	1.1199***	0.1479	-0.0896	0.5076***	0.7332**	0.1098	-0.0432	-0.5203	-0.0603	-0.0503	-0.1380	-0.4708***	0.9069	0.8055	0.0000	0.0000
F15	-0.0029	0.0021	-0.0060	1.2798***	0.2124	0.1774*	0.4927***	1.1488**	-0.4219	0.2606*	0.1337	0.1022	0.0447	0.1477	-0.1366	0.8511	0.3356	0.0087	0.0059
F16	0.0008	-0.0024	0.0007	1.0116***	0.0357	0.0480	0.4569***	0.4902	-0.0222	0.0106	0.1321	0.2844*	-0.0189	-0.0589	-0.0669	0.8965	0.8677	0.0563	0.0619
F17	-0.0019	-0.0019	0.0024	1.1731***	0.0869	0.0608	0.8287***	0.9041*	0.3295	-0.2146*	0.1822	0.5142**	0.0127	0.0799	-0.3025**	0.8007	0.7513	0.0104	0.0263
F18	-0.0093**	-0.0841***	0.0102	1.3143***	0.2183	-0.4956	0.8013***	-1.5988	0.5012	-0.0217	-1.8500	-0.2011	-0.2091	-1.6232*	-0.6725	0.7305	0.0083	0.4602	0.1915
F19	-0.0004	0.0049	-0.0010	1.1056***	0.1225	0.1321	0.1681	0.2748	0.3513	-0.1015	0.5674	0.6208**	-0.0093	0.5588**	0.0122	0.7507	0.7651	0.0116	0.0251
F20	-0.0017	0.0192	0.0004	1.0213***	-0.4170	-0.1961	0.4610**	-0.4007	-0.6244	0.0776	1.0611	-0.3408	-0.1256	-1.3873	-0.6223	0.7774	0.6912	0.5602	0.6233
F21	-0.0023*	0.0039	0.0007	0.8754***	0.1897	0.3644*	0.1121	-0.7915	0.1657	-0.1265	0.0491	0.2624	-0.1119	0.2036	0.3173	0.9592	0.9388	0.7788	0.8629

Appendix 12. Individual performance results of black mutual funds using the conditional four-factor model (FTSE All-World Index)

The table reports individual estimates of European black mutual funds, considering the period December 2003 to November 2019.The results are obtained by the regression of the conditional four-factor model (eq.3), using FTSE All-World Index. Additionally, it presents the performance estimates (α_p), the conditional alphas coefficients (α_{DY}, α_{TB}), the systematic risk (β_{MKT}), the conditional beta estimates (β_{MKT*DY}, β_{MKT*TB}, β_{SMB*DY}, β_{SMB*TB}, β_{HML*DY}, β_{MOM*DY} and β_{MOM*TB}), the regression coefficients of size (SMB), book-to-market (HML) and momentum (MOM) factors and the adjusted coefficient of determination ($Adj.\ R2$). The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. w1, w2 and w3 correspond to the probability values from the Wald test on the existence of time-varying alphas, time-varying betas and joint time-varying alphas and betas.

Panel A: FTSE All-World Index

	α_p	α_{DY}	α_{TB}	β_{MKT}	β_{MKT*DY}	β_{MKT*TB}	β_{SMB}	β_{SMB*DY}	β_{SMB*TB}	β_{HML}	β_{HML*DY}	β_{HML*TB}	β_{MOM}	β_{MOM*DY}	β_{MOM*TB}	Adj. R^2	w1	w2	w3
F1	-0.0031	0.0131	-0.0024	1.1139***	0.4961	0.1882	0.8127**	1.7933*	0.6615	0.1093	-0.0752	1.3521**	-0.1586	0.7598	-0.2573	0.4923	0.6705	0.0165	0.0114
F2	-0.0086**	0.0898**	0.0309**	1.1292***	-0.2013	0.2504	0.5875*	-2.5731	1.2769	0.7419**	4.8444*	1.0548	-0.0489	0.0361	1.0040	0.7949	0.0151	0.4273	0.2080
F3	-0.0005	0.0494	-0.0018	0.8183***	0.4809	0.0013	1.4649***	2.5753	-0.0047	-0.4459	0.4128	1.3879*	0.1319	1.7052*	0.6225	0.1483	0.3876	0.4919	0.2944
F4	-0.0036	0.0082	-0.0013	1.2713***	0.3917	0.1499	0.4758*	1.4259*	1.1235***	0.3592	-0.2239	1.8181***	0.0096	0.4280	-0.0202	0.5957	0.8236	0.0000	0.0000
F5	-0.0000	0.0530	-0.0013	0.8828***	0.3924	-0.0870	1.5976***	2.7686	-0.1127	-0.2768	0.4564	1.5391*	0.1109	1.7265*	0.4586	0.1797	0.3538	0.2736	0.1258
F6	-0.0079**	0.0972***	0.0364**	1.0644***	-0.5440	0.1381	0.3843	-0.0693	1.7092	0.8220***	4.6124*	1.5749*	-0.2205	-1.1014	2.0640***	0.7251	0.0001	0.0359	0.0024
F7	0.0003	0.0643*	0.0411	0.7095***	-0.8564	-3.0229***	1.9050***	2.2466	0.8047	-1.1958**	-0.4280	3.6558**	-0.3896	0.6727	-1.3603	0.1367	0.1241	0.0184	0.0282
F8	-0.0137***	-0.0119	0.0140	1.3808***	0.8056**	0.7825***	0.8625***	0.1743	-0.2477	0.5054**	-0.2944	1.7970***	-0.3562**	0.2547	-0.0298	0.7028	0.3359	0.0003	0.0007
F9	-0.0046	0.0111	-0.0085	1.2930***	0.8276**	0.3400*	0.7558***	1.8214**	0.0488	0.1760	-0.1368	1.9534***	0.0491	1.1308**	0.2170	0.6195	0.3485	0.0000	0.0000
F10	-0.0141***	0.0526	0.0487***	1.3157***	-0.6685	-0.3286	-0.3254	2.6303	3.6266***	0.5927**	1.7423	0.7881	-0.0296	-1.0747	0.9141	0.8367	0.0025	0.1534	0.0377
F11	-0.0064*	0.0064	-0.0054	1.2189***	0.6443*	0.2689	0.7750***	1.8065*	0.4415	0.1090	-0.3381	1.9072***	0.0689	0.7930*	0.2103	0.5769	0.6624	0.0000	0.0000
F12	-0.0021	0.0465	-0.0020	0.9916***	0.5881	0.1371	1.8970***	2.9815	-0.0293	-0.3549	0.3853	1.4541*	0.0777	1.5562*	0.4176	0.2137	0.3814	0.2836	0.0930
F13	-0.0041	0.0065	-0.0089	1.1966***	0.6602*	0.3292*	0.6266***	1.7811*	0.6406*	0.1840	-0.0084	1.6693***	0.0276	1.0470**	0.1711	0.6171	0.3776	0.0004	0.0000
F14	-0.0006	0.0565	-0.0026	0.8187***	0.3255	-0.0443	1.5872***	2.5647	-0.1759	-0.3920	0.8401	1.2336	0.0987	1.6300*	0.5096	0.1508	0.3089	0.5573	0.2723
F15	-0.0044	0.0097	-0.0093	1.2410***	0.6833*	0.1816	0.8018***	1.8139*	0.2840	0.2059	-0.1662	1.7780***	0.0306	1.0710**	0.1807	0.6287	0.4092	0.0000	0.0000
F16	0.0010	0.0524	-0.0015	0.8132***	0.4857	0.1009	1.2519**	3.0243	0.0406	-0.3390	0.4794	1.3510*	-0.0591	1.6599*	0.4609	0.1358	0.3333	0.3752	0.0842
F17	0.0050	0.0662*	0.0035	0.8124***	-0.9882	-2.4356***	1.8588***	1.8602	1.9983	-1.0692*	-0.3875	3.5210**	-0.3163	0.7230	-1.1207	0.1319	0.1759	0.0605	0.0327
F18	-0.0178**	0.0130	0.0194	1.2728***	-1.3070	2.3266**	1.0986**	-1.4612	1.3931	0.8854	-3.1967	0.2054	0.1396	3.2407	0.0461	0.4628	0.7760	0.2760	0.3512
F19	-0.0055	-0.0042	-0.0020	1.5247***	0.7659*	0.3183	0.9030***	2.8268***	0.9207*	0.3350	-1.0180	1.8430***	-0.2113	0.3311	-0.2660	0.6215	0.9577	0.0003	0.0003
F20	-0.0068**	-0.0148	-0.0110	1.3907***	1.0860***	0.4363**	0.4864**	2.1477***	0.4663	0.0640	-1.0934	1.6777***	-0.1481	0.4978	-0.1659	0.7148	0.2953	0.0000	0.0000
F21	0.0100	0.0925**	0.0005	0.9755***	-1.0001	-1.7453**	2.6496***	2.8635	1.5373	-0.9884	1.0312	3.0497*	-0.5472	0.9626	-0.9849	0.2588	0.0576	0.0236	0.0158
F22	-0.0058	-0.0068	0.0041	1.3976***	0.6756	0.0521	2.2363***	2.7742**	0.8358	-0.0899	-1.7274	2.4272***	-0.1806	0.2403	-0.1555	0.5786	0.8644	0.0014	0.0024
F23	-0.0046*	0.0060	-0.0087*	1.1810***	0.3761	0.2288*	0.3148*	0.0064	0.7791**	0.5650***	0.7021	1.7184***	-0.0365	0.6385**	-0.0715	0.6920	0.1338	0.0000	0.0000
F24	0.0003	0.0422	-0.0078	0.8689***	0.9653	0.3474	1.3409**	2.7647	-0.6550	-0.3070	0.3651	1.7190**	-0.0231	2.0724**	0.7607	0.1651	0.3147	0.0741	0.0180
F25	0.0044	0.0211	0.0048	0.5927***	-0.0927	-0.1509	1.2771**	2.4682	0.1279	-0.3687	1.5647	0.6429	-0.4374	1.0830	-0.3090	0.0960	0.7657	0.3518	0.5222
F26	-0.0089**	0.0291	0.0323**	1.1433***	0.6581	0.2298	0.2767	-2.0378	1.0789	0.8067***	0.4548	0.3612	-0.1414	0.6514	1.1482	0.6933	0.0564	0.7525	0.3154
F27	-0.0076***	-0.0028	-0.0043	1.3567***	0.6892***	0.4385***	0.4580**	-0.0023	0.4358	0.4499**	-0.4556	1.7926***	-0.0685	0.5035	-0.1054	0.7194	0.7372	0.0000	0.0000
F28	-0.0107***	0.0427	0.0415**	1.1595***	0.1361	-0.1155	1.0186***	0.6278	0.7194	-0.1295	-0.3103	1.7204	-0.3407*	0.1515	0.8687	0.6341	0.0238	0.8982	0.4756

Appendix 13. Individual performance results of green mutual funds using the conditional four-factor model (FTSE4GOOD Global Index)

The table reports individual estimates of European green mutual funds, considering the period December 2003 to November 2019.The results are obtained by the regression of the conditional four-factor model (eq.3), using FTSE4GOOD Global Index. Additionally, it presents the performance estimates (α_p), the conditional alphas coefficients (α_{DY}, α_{TB}), the systematic risk (β_{MKT}), the conditional beta estimates (β_{MKT*DY}, β_{MKT*TB}, β_{SMB*DY}, β_{SMB*TB}, β_{HML*DY}, β_{MOM*DY} and β_{MOM*TB}), the regression coefficients of size (SMB), book-to-market (HML) and momentum (MOM) factors and the adjusted coefficient of determination ($Adj.\ R2$). The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. w1, w2 and w3 correspond to the probability values from the Wald test on the existence of time-varying alphas, time-varying betas and joint time-varying alphas and betas.

Panel B: FTSE4GOOD Global Index

	α_p	α_{DY}	α_{TB}	β_{MKT}	β_{MKT*DY}	β_{MKT*TB}	β_{SMB}	β_{SMB*DY}	β_{SMB*TB}	β_{HML}	β_{HML*DY}	β_{HML*TB}	β_{MOM}	β_{MOM*DY}	β_{MOM*TB}	Adj. R^2	w1	w2	w3
F1	0.0070	0.0988**	-0.0131	1.1488***	-0.9249	0.1787	1.1731**	-4.6508	-0.1502	0.3335	4.4105	-1.0468	0.2589	1.0870	-1.5079	0.8959	0.0808	0.3208	0.2741
F2	-0.0047***	0.0026	0.0045	1.0034***	0.2144	0.0730	0.5035***	0.6899	-0.0970	-0.2540***	0.8134	0.1691	0.0595	-0.0536	0.0562	0.8728	0.6862	0.8945	0.7323
F3	-0.0067**	0.0328	0.0262**	1.0202***	0.3010	0.2209	0.6711***	3.7070**	0.5789	0.4691***	2.7634	0.3584	-0.1418	-0.4241	0.4005	0.7530	0.0110	0.2096	0.0008
F4	-0.0038*	0.0041	-0.0027	1.0706***	0.4601**	0.1047	0.5430***	1.3473***	0.1856	0.2262*	-0.1251	0.3846	-0.0128	0.2730	-0.1477	0.7893	0.6461	0.0396	0.0393
F5	-0.0049***	0.0096	0.0005	0.9630***	0.0747	0.0672	0.3037***	0.2144	-0.3167*	-0.0829	0.3809	0.3557	0.0566	0.4057**	0.0796	0.8176	0.3019	0.0003	0.0003
F6	-0.0099	0.0108	0.0054	1.2129***	0.3243	-0.6340	-0.7302	-3.6485	2.6965*	0.0119	-5.6406	0.0804	0.0380	-0.9617	0.5240	0.8876	0.9083	0.3640	0.2677
F7	-0.0023	0.0047	-0.0038	1.0250***	0.0228	0.0386	0.0853	0.2485	-0.2786	-0.1283	0.0275	-0.0686	-0.0001	0.2421	-0.0363	0.8300	0.3372	0.4390	0.4390
F8	-0.0060***	0.0204	0.0057	1.0616***	0.0440	-0.0397	0.4316***	1.0076	0.2806	-0.1317	2.3048	0.0325	0.0718	-0.2929	0.1096	0.8447	0.2016	0.0351	0.0650
F9	0.0002	0.0044	-0.0011	1.0349***	0.0869	0.0595	1.0005***	0.7324**	-0.0501	-0.1388	0.0535	0.4871**	0.0361	0.1046	-0.0351	0.8499	0.6642	0.0243	0.0172
F10	-0.0025	-0.0009	-0.0008	1.2197***	0.2708	-0.1077	0.7643***	1.0291*	0.1497	-0.3219***	-0.3634	0.5515	-0.0392	-0.0500	-0.1890	0.8848	0.9864	0.0000	0.0000
F11	-0.0055***	0.0057	-0.0009	1.1075***	0.0271	-0.1064	0.5163***	0.6645	-0.1249	-0.1985*	-0.3678	0.3413	0.0354	-0.1930	-0.1574	0.8611	0.4705	0.0000	0.0000
F12	-0.0108***	0.0025	0.0266**	1.2309***	1.1290***	-0.6666*	1.0051***	0.7473	1.4998	0.4777***	0.3771	-0.2828	0.0632	-1.5456**	0.5230	0.8226	0.1186	0.0019	0.0019
F13	-0.0054*	0.0035	-0.0031	1.2942***	0.6738**	0.0927	0.9474***	2.0651***	0.7234**	0.0460	-0.6794	1.4658***	0.1469	0.2135	0.1065	0.7742	0.6301	0.0003	0.0000
F14	-0.0040**	-0.0069	-0.0033	1.0855***	0.3217**	-0.0460	0.6562***	0.9341**	0.1367	-0.1098	-0.8644*	0.1198	-0.0407	-0.1661	-0.5080***	0.8867	0.6025	0.0000	0.0000
F15	-0.0030	-0.0010	-0.0068	1.2490***	0.4279*	0.2254	0.6699***	1.3724**	-0.3272	0.1886	-0.2460	0.2709	0.0572	0.1463	-0.1663	0.8461	0.3545	0.0002	0.0000
F16	0.0011	-0.0049	-0.0000	0.9808***	0.2113*	0.0930	0.5838***	0.6442**	0.0111	-0.0222	-0.1152	0.4680***	0.0079	-0.0444	-0.0537	0.8758	0.6408	0.0092	0.0209
F17	-0.0016	-0.0044	0.0016	1.1370***	0.2808	0.1009	0.9784***	1.0838**	0.3669**	-0.2536**	-0.1124	0.7218**	0.0444	0.0957	-0.2918	0.7821	0.7983	0.0000	0.0000
F18	-0.0097***	-0.0801***	0.0124	1.2499***	0.6659	-0.3758	1.0259***	-1.3512	0.1761	-0.0558	-2.1879	-0.0213	-0.1801	-1.6122	-0.5879	0.7264	0.0124	0.2154	0.1439
F19	0.0001	0.0017	-0.0016	1.0545***	0.3205	0.1815*	0.3038**	0.4669	0.4084	-0.1328	0.2639	0.8086***	0.0162	0.5658**	0.0311	0.7079	0.8864	0.0089	0.0191
F20	-0.0018	0.0299	0.0015	0.9649***	-0.2231	-0.0157	0.5632***	-0.1089	-0.6469	0.1109	1.5200	-0.2339	-0.1196	-1.4406	-0.4543	0.7448	0.4496	0.6072	0.5164
F21	-0.0032**	0.0178	0.0029	0.8648***	0.0982	0.4071*	0.1834	-0.5238	0.3138	-0.0872	0.3355	0.3442	-0.0846	-0.3679	0.4159	0.9382	0.4389	0.7417	0.5199

Appendix 14. Individual performance results of black mutual funds using the conditional four-factor model (FTSE All-World Mining Index)

The table reports individual estimates of European black mutual funds, considering the period December 2003 to November 2019.The results are obtained by the regression of the conditional four-factor model (eq.3), using FTSE All-World Mining Index. Additionally, it presents the performance estimates (α_p), the conditional alphas coefficients (α_{DY}, α_{TB}), the systematic risk (β_{MKT}), the conditional beta estimates (β_{MKT*DY}, β_{MKT*TB}, β_{SMB*DY}, β_{SMB*TB}, β_{HML*DY}, β_{MOM*DY} and β_{MOM*TB}), the regression coefficients of size (SMB), book-to-market (HML) and momentum (MOM) factors and the adjusted coefficient of determination ($Adj.\ R2$). The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. w1, w2 and w3 correspond to the probability values from the Wald test on the existence of time-varying alphas, time-varying betas and joint time-varying alphas and betas.

Panel C: FTSE All-World Mining Index

	α_p	α_{DY}	α_{TB}	β_{MKT}	β_{MKT*DY}	β_{MKT*TB}	β_{SMB}	β_{SMB*DY}	β_{SMB*TB}	β_{HML}	β_{HML*DY}	β_{HML*TB}	β_{MOM}	β_{MOM*DY}	β_{MOM*TB}	Adj. R^2	w1	w2	w3
F1	-0.0009	0.0068	-0.0037	0.7511***	0.0894	0.0057	0.2479	0.2501	-0.2525	0.0139	0.3997	0.0899	-0.0870	0.6042**	-0.0018	0.8243	0.5164	0.3625	0.4671
F2	-0.0027	-0.0142	0.0036	0.3103***	-0.3586	0.1748	-0.1852	-2.5220	2.1713	-0.4012	-4.5480	0.8903	-1.0330***	-2.8576	1.4947	0.4888	0.9560	0.6739	0.8198
F3	-0.0027	0.0522**	-0.0079	0.9790***	-0.0592	0.0836	0.7805**	-0.2495	-1.4378**	-0.8207**	1.5974	-0.1112	0.1453	1.7259***	0.7043*	0.6066	0.0130	0.0287	0.0239
F4	-0.0010	-0.0014	-0.0000	0.8338***	-0.0069	0.0126	-0.0335	-0.3221	0.2077	0.1150	-0.0060	0.2726*	-0.0734	0.0721	-0.0008	0.9615	0.9529	0.1437	0.2668
F5	-0.0019	0.0529**	-0.0071	0.9866***	-0.0627	0.0422	0.9061***	0.0107	-1.5105**	-0.6270**	1.5660	0.0222	0.1210	1.7426***	0.5780*	0.6308	0.0105	0.0174	0.0126
F6	-0.0018	-0.0153	-0.0111	0.4355***	-0.5659	0.2710	-0.1633	-0.7917	1.1511	0.0617	-3.3614	0.0847	-0.5555***	-4.2297***	0.7732	0.7366	0.5972	0.1578	0.2425
F7	-0.0023	0.0335	0.0106	0.9771***	-0.2601	-0.6636**	1.0493**	-0.2134	-2.0877	-0.7392**	1.7547	0.9494	0.1233	0.9278	-0.2333	0.5652	0.3858	0.1106	0.1682
F8	-0.0070	-0.0257	0.0017	0.5901***	0.2385	0.0253	0.2529	-0.4112	-0.5173	0.3425	-0.6703	-0.0246	-0.4884**	-0.2541	-0.2672	0.5933	0.3409	0.7899	0.8211
F9	-0.0005	0.0036	-0.0037	0.7293***	0.1930*	-0.0215	0.3583**	0.5090	-0.6430**	-0.0008	0.2236	0.3688	-0.0463	0.6877***	0.1920	0.7921	0.3555	0.0012	0.0003
F10	-0.0063	-0.0388	0.0190	0.2706**	-0.4563	0.3053	-0.9763	2.3629	4.2167*	-0.5637	-5.9056	0.8690	-1.1946***	-3.5766	2.0114	0.4921	0.5304	0.2882	0.4174
F11	-0.0037***	-0.0015	-0.0035	0.7894***	0.0907	0.0474	0.3013**	0.1770	-0.4318**	-0.1357	0.0362	0.3860*	-0.0215	0.4018**	0.1889	0.8982	0.3347	0.0002	0.0001
F12	-0.0030	0.0486**	-0.0061	1.0042***	-0.0396	0.0900	1.2280***	0.2284	-1.4269**	-0.7320**	1.4171	-0.1902	0.0649	1.4549***	0.4532	0.6339	0.0262	0.0574	0.0449
F13	-0.0001	0.0006	-0.0038	0.6506***	0.0906	-0.0278	0.2925*	0.5655	0.0387	0.0216	0.1536	0.2395	-0.0639	0.5947*	0.1303	0.7482	0.5227	0.0999	0.0370
F14	-0.0026	0.0597**	-0.0081	0.9503***	-0.1318	0.0403	0.9355**	-0.2033	-1.5417**	-0.7410**	1.8563***	-0.2291	0.1182	1.6543***	0.6047*	0.5878	0.0651	0.0201	0.0436
F15	-0.0004	0.0018	-0.0036	0.6749***	0.1290	-0.1111	0.4485**	0.5649	-0.3082	0.0797	0.1540	0.2877	-0.0511	0.6441**	0.2151	0.7616	0.5085	0.1673	0.0786
F16	-0.0004	0.0564**	-0.0066	0.9152***	-0.0276	0.0818	0.6274*	0.4755	-1.2653*	-0.6811**	1.5002	-0.1164	-0.0465	1.6826***	0.5078	0.5431	0.0152	0.0658	0.0379
F17	0.0032	0.0385	-0.0344	1.0362***	-0.3521	-0.3580	0.9570**	-0.6620	-0.7699	-0.7592**	1.2289	0.8641	0.1701	0.9290	-0.2006	0.5961	0.0916	0.2328	0.0405
F18	-0.0143	-0.1256	-0.0192	0.3268**	-0.8648	0.8537	0.5801	0.6132	0.9058	-0.2283	-14.6721**	-1.6799	-0.5643	-3.1825	-1.2282	0.1788	0.2779	0.2646	0.3868
F19	-0.0020	-0.0143	0.0007	0.9678***	0.1061	0.0395	0.3279*	0.8600*	-0.1270	0.0463	-0.6048	-0.0406	-0.3228***	-0.1557	-0.2853**	0.9149	0.3463	0.0037	0.0037
F20	-0.0019	-0.0207*	-0.0032	0.7194***	0.2241*	-0.0611	0.1407	0.8412	-0.1594	-0.0975	-0.6557	-0.0197	-0.2606**	-0.0901	-0.2160	0.7835	0.1993	0.0628	0.0722
F21	0.0081	0.0602**	-0.0377	1.1737***	-0.2600	-0.1361	1.6757***	0.7060	-1.5988	-0.8309**	2.0310	0.6395	-0.0273	1.2570*	-0.1302	0.6628	0.0041	0.1389	0.0092
F22	-0.0047	-0.0161	0.0046	0.9578***	-0.0170	-0.0117	1.5202***	0.4554	-0.3580	-0.2332	-0.9185	0.9769*	-0.1140	-0.1423	0.2404	0.7940	0.3865	0.1930	0.3143
F23	0.0004	-0.0081	-0.0024	0.4859***	0.0736	-0.0402	0.0808	-0.5403	0.4745	0.4783**	0.3739	0.5823	-0.1610	0.1092	-0.1028	0.5417	0.8148	0.5420	0.6612
F24	-0.0012	0.0487**	-0.0129	0.9886***	0.1153	0.1874	0.6722*	0.0154	-2.1110***	-0.7219**	1.7355*	0.0760	-0.0323	2.0057***	0.7252**	0.6051	0.0098	0.0016	0.0013
F25	0.0028	0.0114	-0.0092	0.8066***	0.0892	0.2946**	0.6474	0.9965	-0.5752	-0.4604	2.4764**	0.3633	-0.1057	1.4678***	0.3132	0.5032	0.4967	0.0236	0.0565
F26	-0.0022	-0.0506	-0.0044	0.3507***	-0.0349	-0.2395	-0.2203	-2.3167	1.2365	0.0057	-8.9696**	-0.3786	-0.6448**	-4.4251*	0.7147	0.4091	0.5585	0.2074	0.3481
F27	-0.0016	-0.0161	0.0037	0.5486***	0.1556	-0.0000	0.2124	-0.6110	0.0854	0.3313	-0.7218	0.4363	-0.2213	-0.1605	-0.2032	0.5466	0.3828	0.4585	0.5956
F28	-0.0004	0.0100	-0.0143	0.6968***	0.0827	-0.5639**	0.1309	-0.3043	1.3191	-0.2210	-0.4926	-1.0552	-0.2302	-0.0154	-1.3878*	0.7655	0.5748	0.1771	0.2240

Appendix 15. Individual performance results of green mutual funds using the conditional five-factor model (FTSE All-World Index

The table reports individual estimates of European green mutual funds, considering the period December 2003 to November 2019.The results are obtained by the regression of the conditional five-factor model (eq.8), using FTSE All-World benchmark. Additionally, it presents the performance estimates (α_p), the conditional alphas coefficients (α_{DY}, α_{TB}), the systematic risk (β_{MKT}), the conditional beta estimates (β_{MKT*DY}, β_{MKT*TB}, β_{SMB*DY}, β_{SMB*TB}, β_{HML*DY}, β_{CMA*DY}, β_{CMA*TB}, β_{RMW*DY} and β_{RMW*TB}), the regression coefficients of size (SMB), book-to-market (HML), investments (CMA) and profitability (RMW) factors and the adjusted coefficient of determination ($Adj.\ R2$). The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. w1, w2 and w3 correspond to the probability values from the Wald test on the existence of time-varying alphas, time-varying betas and joint time-varying alphas and betas.

Panel A: FTSE All-World Index

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
α_p	-0.0054	-0.0040***	-0.0080***	-0.0049**	-0.0051***	-0.0053	-0.0033*	-0.0044***	-0.0019	-0.0030	-0.0056***
α_{DY}	0.1079**	-0.0011	0.0117	-0.0001	0.0086	0.0404	0.0005	0.0196	-0.0027	-0.0050	0.0094
α_{TB}	0.0158	0.0017	0.0271***	-0.0004	0.0018	0.0002	-0.0034	0.0010	0.0018	-0.0008	0.0009
β_{MKT}	1.4004***	1.0444***	1.1580***	1.0492***	0.9360***	1.4894***	1.0551***	1.0751***	1.0933***	1.2513***	1.1368***
β_{MKT*DY}	-1.5284**	-0.1701	0.9405*	0.2151	-0.1683	-0.0736	-0.1527	-0.3884	0.0911	0.2140	0.0607
β_{MKT*TB}	-0.2851	0.0824	0.1442	-0.0313	-0.0192	-0.9519**	-0.0512	0.0238	0.0017	-0.1302	-0.0769
β_{SMB}	1.7141***	0.4172***	0.5337***	0.3012*	0.1070	0.4236	-0.0456	0.3020**	0.8960***	0.5706***	0.3691***
β_{SMB*DY}	-5.2195	-0.1575	3.6561**	0.9997*	-0.0403	-1.7157	0.1538	0.0817	0.8448**	0.8588**	0.5373
β_{SMB*TB}	-0.9736	0.0119	1.0549	0.0339	-0.2463	0.2080	-0.2449	0.5493	-0.1429	0.1429	-0.1922
β_{HML}	-0.8870	-0.2702*	0.5298*	0.3891**	-0.1161	-1.4528***	-0.1271	-0.1498	-0.0863	0.0437	-0.0694
β_{HML*DY}	-0.2114	0.0998	1.5291	-0.0621	-0.0422	-12.8357***	0.0875	2.0007	0.0928	0.2746	-0.3658
β_{HML*TB}	4.2491*	0.4473	-1.9776	0.5909	0.2637	4.7646***	0.0604	0.3178	0.3432	0.8424**	0.1577
β_{CMA}	2.4604*	0.0653	0.0416	-0.3208	0.0197	3.1261***	0.1632	0.0204	0.1364	-0.5120**	-0.1341
β_{CMA*DY}	1.5739	1.5826	3.8371	-0.0835	0.2264	11.0342***	-0.0286	0.6872	0.1376	0.3384	0.8772
β_{CMA*TB}	-6.8070	-0.4513	4.1320*	-0.7625	-0.1160	-8.4522***	-0.2573	-0.3493	-0.2696	-0.4624	0.1870
β_{RMW}	1.8260**	0.0960	-0.0903	0.0004	-0.1138	0.0512	0.0857	-0.0170	0.3527**	0.1950	0.0810
β_{RMW*DY}	0.9115	-1.6421	-1.1189	-0.1724	-0.7095	-3.9776	0.3486	-1.6543	0.7729*	1.0706*	-0.0973
β_{RMW*TB}	-0.5282	0.2348	0.3289	-0.4045	0.1151	2.2733*	0.2788	0.8033	-0.5643	0.0958	-0.2517
Adj. R^2	0.8982	0.8919	0.8055	0.7797	0.7956	0.9559	0.8193	0.8451	0.8748	0.9039	0.8818
w1	0.0744	0.9218	0.0029	0.9958	0.3620	0.3489	0.6892	0.4406	0.7718	0.8217	0.5331
w2	0.0550	0.5791	0.0044	0.5604	0.0002	0.0002	0.8135	0.0861	0.0964	0.0946	0.0000
w3	0.0072	0.0477	0.0000	0.5849	0.0002	0.0004	0.8800	0.0248	0.0499	0.1202	0.0000

Appendix 15. (continued)

	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21
α_p	-0.0063**	-0.0063**	-0.0056***	-0.0043*	0.0002	-0.0024	-0.0060	-0.0043**	-0.0005	-0.0039***
α_{DY}	0.0136	-0.0076	-0.0184	-0.0123	-0.0096*	-0.0170	-0.0752**	-0.0117	0.0360	0.0097
α_{TB}	0.0153	-0.0029	-0.0018	-0.0064	0.0012	0.0003	0.0053	-0.0029	-0.0013	0.0016
β_{MKT}	1.2116***	1.3103***	1.1524***	1.3249***	1.0350***	1.1189***	1.2749***	1.0780***	1.0995***	0.9908***
β_{MKT*DY}	0.6227	0.5662*	0.4377**	0.1936	0.1717	0.3451	1.0899	0.4442**	0.7016	0.1222
β_{MKT*TB}	-0.2682	-0.0796	0.0050	0.2461*	0.0614	0.1767	-0.0644	0.3602***	-0.0982	0.1218
β_{SMB}	0.6764***	0.7418***	0.4659***	0.4583**	0.4615***	0.6901***	0.5556*	0.1293	0.4570**	0.3517***
β_{SMB*DY}	-0.3795	1.9977**	0.8541***	1.1856**	0.7054**	0.7786	0.2332	0.1315	-0.2772	-1.6719**
β_{SMB*TB}	2.5113**	0.7739**	-0.0886	-0.5512*	-0.1055	0.1540	1.1886	0.3282	-0.6222	-0.2616
β_{HML}	0.3120	0.2199	-0.0553	-0.0890	0.0066	-0.1246	0.3356	0.4345***	-0.0575	-0.0471
β_{HML*DY}	-0.9577	-0.4082	-0.4452	0.4089	0.3236	-0.1455	0.0212	-0.3065	-1.1790	-2.3507**
β_{HML*TB}	-1.4498	1.8490***	0.3465	-0.0404	0.2731	0.7768**	-2.8435	0.5801*	0.1186	1.2745***
β_{CMA}	0.1228	-0.5372*	0.1010	0.6259**	0.1027	-0.4520**	-1.0748**	-0.8454***	0.4280	0.2176
β_{CMA*DY}	4.5621*	0.4077	0.5035	-0.1393	-0.0116	1.4481*	2.6179	2.1140***	4.7241	2.2102*
β_{CMA*TB}	1.9822	-1.0607	-0.2177	0.3836	-0.0722	0.0556	6.3631**	0.3595	0.1862	-1.8867**
β_{RMW}	-0.5516	0.1502	0.1413	-0.0387	0.1302	-0.0882	-0.6868	0.8862***	-0.4011	0.3875**
β_{RMW*DY}	-4.0512*	1.0692	1.0810*	1.2104	0.9801**	0.8691	3.8859	1.2427*	-4.3280	-2.6687**
β_{RMW*TB}	1.5117	0.2144	-0.7855*	-0.3080	-0.3767	-0.2542	1.1187	0.3159	1.1755	0.0182
Adj. R^2	0.8197	0.7939	0.8994	0.8524	0.9002	0.7957	0.7406	0.7906	0.7675	0.9730
w1	0.3915	0.8932	0.2632	0.3283	0.1264	0.2565	0.0466	0.3948	0.4082	0.5952
w2	0.0188	0.0012	0.0002	0.0084	0.0195	0.0126	0.3276	0.0000	0.6541	0.0471
w3	0.0238	0.0000	0.0004	0.0093	0.0400	0.0182	0.2782	0.0001	0.6179	0.0725

Appendix 16. Individual performance results of black mutual funds using the conditional five-factor model (FTSE All-World Index)

The table reports individual estimates of European black mutual funds, considering the period December 2003 to November 2019.The results are obtained by the regression of the conditional five-factor model (eq.4), using FTSE All-World Index. Additionally, it presents the performance estimates (α_p), the conditional alphas coefficients (α_{DY}, α_{TB}), the systematic risk (β_{MKT}), the conditional beta estimates (β_{MKT*DY}, β_{MKT*TB}, β_{SMB*DY}, β_{SMB*TB}, β_{HML*DY}, β_{CMA*DY}, β_{CMA*TB}, β_{RMW*DY} and β_{RMW*TB}), the regression coefficients of size (SMB), book-to-market (HML), investments (CMA) and profitability (RMW) factors and the adjusted coefficient of determination ($Adj.\ R2$). The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. w1, w2 and w3 correspond to the probability values from the Wald test on the existence of time-varying alphas, time-varying betas and joint time-varying alphas and betas.

Panel A: FTSE All-World Index

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14
α_p	-0.0053	-0.0041	0.0012	-0.0044	0.0008	-0.0075*	-0.0036	-0.0140***	-0.0063*	-0.0126***	-0.0066	-0.0004	-0.0047	0.0008
α_{DY}	0.0057	0.0830**	0.0363	0.0106	0.0345	0.1008***	0.0741*	0.0135	-0.0019	0.0360	0.0045	0.0377	-0.0096	0.0443
α_{TB}	-0.0074	0.0185	-0.0113	-0.0032	-0.0070	0.0321**	0.0487	0.0182	-0.0111	0.0463***	-0.0068	-0.0125	-0.0124**	-0.0123
β_{MKT}	1.0157***	1.3411***	0.5321**	1.1471***	0.6004***	1.1940***	0.5943**	1.3001***	1.1213***	1.6269***	1.0462***	0.7093***	1.0049***	0.5471**
β_{MKT*DY}	1.3549***	-0.3298	1.3145	0.5802	1.3636	0.2216	-0.0229	0.6039	1.2852***	-0.3178	0.9507**	1.4564	1.1593***	1.2366
β_{MKT*TB}	1.0285***	-0.2973	0.6118	0.5350*	0.4837	0.0483	-1.7290*	0.7266**	0.9008***	-1.0222*	0.7233**	0.9343*	0.7434***	0.5728
β_{SMB}	0.7805**	0.5846	1.2775**	0.3761	1.4006***	0.3708	1.9269***	0.7511**	0.6276***	-0.2953	0.6621**	1.7093***	0.4244**	1.4111***
β_{SMB*DY}	1.1288	-2.8661	1.8258	0.7251	2.1832	-1.1346	1.2267	-0.5364	1.1379	2.8165	1.1162	2.0206	1.2363*	1.8476
β_{SMB*TB}	0.6751	0.9272	0.6655	1.1103***	0.3918	2.3599*	2.1639	-0.7331	0.2096	3.5082***	0.5870	0.5334	0.7629**	0.4465
β_{HML}	0.5105	-0.1636	0.1677	0.8569***	0.2207	0.8795**	-0.5610	0.9890***	0.8511***	-0.2789	0.6734**	0.1758	0.8096***	0.1176
β_{HML*DY}	-3.1132***	4.2745	-4.3490*	-1.5938*	-4.6855**	2.4335	-4.6658*	-1.1180	-2.6065***	0.5800	-2.4186**	-4.3873**	-2.4111***	-4.1488**
β_{HML*TB}	0.0941	0.9867	0.8325	1.1994**	0.9380	-1.8084	2.9288	0.6126	1.1221**	1.0743	1.1064*	0.4548	1.2713**	0.6689
β_{CMA}	-0.4707	1.6514**	-1.9966*	-1.0660**	-1.7161	0.1608	-0.2059	-0.8097*	-1.4961***	1.6864**	-1.3743**	-1.6837	-1.6604***	-1.7102**
β_{CMA*DY}	6.8823***	-0.5820	9.4339***	3.1396**	9.6032***	7.5453*	8.1303**	0.4177	5.5111***	0.4507	4.5091***	9.9774***	5.2934***	9.6568***
β_{CMA*TB}	4.0507***	-1.8782	3.2144	1.6339	3.0034	4.0880	4.3397	0.3909	2.3871***	-1.8446	2.0608*	4.3660**	1.5707**	3.3812*
β_{RMW}	0.3559	-1.2246**	-0.2822	0.2303	-0.3178	-0.1864	0.4162	-0.3004	0.4229	-0.8543*	0.1359	-0.3357	0.0507	-0.3144
β_{RMW*DY}	-0.7207	-2.7510	-1.2594	-1.0828	-1.3908	-5.8732	-3.0016	-2.5856*	-0.0741	-2.4284	-0.9966	-1.5682	0.1169	-1.5479
β_{RMW*TB}	0.9725	1.5396	3.5329*	0.4336	2.4060	-0.1268	3.2759	-2.2889	1.0470	1.7118	0.7790	3.4980*	0.9530	3.4523**
Adj. R^2	0.5276	0.8249	0.2039	0.6146	0.2229	0.7219	0.1440	0.7054	0.6556	0.8598	0.6088	0.2680	0.6630	0.2087
w1	0.6628	0.0483	0.4058	0.6755	0.5386	0.0003	0.1205	0.4631	0.2623	0.0027	0.5986	0.3062	0.1425	0.1827
w2	0.0003	0.4771	0.0160	0.0001	0.0085	0.0682	0.0142	0.0007	0.0000	0.1363	0.0000	0.0032	0.0000	0.0078
w3	0.0004	0.2938	0.0188	0.0000	0.0072	0.0043	0.0193	0.0012	0.0000	0.0318	0.0000	0.0040	0.0000	0.0060

Appendix 16. (continued)

	F15	F16	F17	F18	F19	F20	F21	F22	F23	F24	F25	F26	F27	F28
α_p	-0.0055*	0.0009	-0.0011	-0.0239**	-0.0068	-0.0069**	0.0082	-0.0042	-0.0091***	0.0014	0.0002	-0.0123***	-0.0108***	-0.0140***
α_{DY}	-0.0008	0.0461	0.0661	-0.0452	0.0062	-0.0140	0.1180**	0.0149	-0.0035	0.0353	0.0297	0.0157	-0.0065	0.0461
α_{TB}	-0.0122*	-0.0112	0.0317	0.0283	-0.0042	-0.0140**	-0.0040	0.0024	-0.0070	-0.0159	0.0017	0.0381**	-0.0036	0.0487**
β_{MKT}	1.0345***	0.5992***	0.7232***	1.3366***	1.3538***	1.1804***	0.7804***	1.2155***	1.1425***	0.5909***	0.5688**	1.2876***	1.2908***	1.2559***
β_{MKT*DY}	1.1399***	1.2848	0.3367	-1.6808	0.9877**	1.3763***	0.0721	0.9937	0.7424**	1.5468*	0.2214	1.4141	0.9825***	0.8540
β_{MKT*TB}	0.6664***	0.7358	-1.8692*	2.2465**	0.8062**	0.8653***	-0.2910	1.0632***	0.5986***	0.8464*	0.6602	0.0944	0.8007***	-0.0479
β_{SMB}	0.6126***	1.1261**	2.0203***	1.2176*	0.6842**	0.1986	2.6185***	1.9919***	0.3165*	1.1424**	1.2256**	0.4216	0.4111**	1.2086***
β_{SMB*DY}	1.0729	2.2712	1.6489	-1.2298	1.8024*	1.2396	1.4713	1.3616	-0.3121	1.9129	1.3996	-3.1160	-0.4553	1.0255
β_{SMB*TB}	0.3978	0.5925	2.5659	1.7349	0.5947	0.2185	3.1448	0.3296	0.6787**	0.0419	-0.1085	1.3954	0.2980	1.4171
β_{HML}	0.9531***	0.1561	-0.5147	0.5990	1.1513***	0.8817***	-0.2274	0.3780	1.0167***	0.3109	-0.4431	0.8139**	0.9309***	0.6788**
β_{HML*DY}	-2.7604***	-4.3600**	-6.1088**	-4.1130	-2.5300**	-2.6648***	-4.9836*	-3.4009**	-0.9152	-4.6021**	-1.5485	-3.5105	-1.9008**	0.2649
β_{HML*TB}	1.1544**	0.4965	3.9094	-1.6965	0.8282	0.9847*	1.1961	-0.4867	1.0277**	1.0517	-1.6664	-4.3627***	1.0804**	-2.7529
β_{CMA}	-1.8133***	-1.2315	-0.3343	0.6528	-1.5321**	-1.8972***	-0.6170	-1.0432	-0.4696	-1.8311**	0.8233	0.1535	-0.6535**	-0.9753*
β_{CMA*DY}	5.5248***	8.9483***	8.7862**	-0.2919	3.5332**	3.9657***	11.1733***	5.4222***	2.9587***	8.6843***	5.2045*	7.4432*	2.8086***	4.5917
β_{CMA*TB}	1.9107**	3.7330**	2.3825	3.5520	2.0295	1.5568*	6.9133*	5.2996***	1.4402**	2.9959	4.9580**	6.6041**	1.4613**	7.8874**
β_{RMW}	0.2085	-0.0968	0.6813	0.4820	0.1333	-0.1395	-0.0357	-0.4590	0.9018***	-0.4225	-0.1110	0.4915	0.6242**	0.8798*
β_{RMW*DY}	-0.5674	-1.7725	-3.2417	5.2369	-1.7891	-0.9940	-4.7421	-2.0986	-0.1043	-2.0611	-2.4546	-6.6289	-0.5306	-0.5641
β_{RMW*TB}	0.9111	3.4326**	0.6945	-0.2210	-0.2671	-0.0696	4.5647	-0.4095	-0.3283	3.5627**	0.4910	-4.0335*	-0.2882	-1.9136
Adj. R^2	0.6799	0.1799	0.1753	0.4548	0.6459	0.7604	0.2960	0.6183	0.7121	0.2045	0.0902	0.7463	0.7335	0.6520
w1	0.1532	0.1946	0.2466	0.6787	0.7404	0.1216	0.0221	0.8418	0.4158	0.2188	0.6530	0.0203	0.7945	0.0083
w2	0.0000	0.0173	0.0081	0.5151	0.0000	0.0000	0.0033	0.0003	0.0000	0.0102	0.39000	0.0398	0.0000	0.1646
w3	0.0000	0.0102	0.0047	0.5245	0.0000	0.0000	0.0017	0.0004	0.0000	0.0076	0.5384	0.0077	0.0000	0.0238

Appendix 17. Individual performance results of green mutual funds using the conditional five-factor model (FTSE4GOOD Global Index)

The table reports individual estimates of European green mutual funds, considering the period December 2003 to November 2019.The results are obtained by the regression of the conditional five-factor model (eq.4), using FTSE4GOOD Global Index. Additionally, it presents the performance estimates (α_p), the conditional alphas coefficients (α_{DY}, α_{TB}), the systematic risk (β_{MKT}), the conditional beta estimates (β_{MKT*DY}, β_{MKT*TB}, β_{SMB*DY}, β_{SMB*TB}, β_{HML*DY}, β_{CMA*DY}, β_{CMA*TB}, β_{RMW*DY} and β_{RMW*TB}), the regression coefficients of size (SMB), book-to-market (HML), investments (CMA) and profitability (RMW) factors and the adjusted coefficient of determination ($Adj.\ R2$). The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. w1, w2 and w3 correspond to the probability values from the Wald test on the existence of time-varying alphas, time-varying betas and joint time-varying alphas and betas.

Panel B: FTSE4GOOD Global Index											
	F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**	**F10**	**F11**
α_p	-0.0096	-0.0053***	-0.0086***	-0.0053**	-0.0058***	-0.0120*	-0.0036*	-0.0060***	-0.0018	-0.0030	-0.0055***
α_{DY}	0.1272***	0.0023	0.0203	-0.0022	0.0085	0.0571*	-0.0023	0.0219	-0.0041	-0.0076	0.0069
α_{TB}	0.0294	0.0056	0.0305***	-0.0019	0.0031	0.0192	-0.0047	0.0057	0.0009	-0.0019	-0.0001
β_{MKT}	1.4351***	1.0287***	1.1204***	1.0292***	0.9308***	1.5721***	1.0377***	1.0736***	1.0535***	1.2063***	1.0896***
β_{MKT*DY}	-1.5504***	0.0972	1.0433	0.5083**	0.0147	-0.0496	0.1434	-0.0886	0.3301*	0.6160***	0.4241**
β_{MKT*TB}	-0.2237	0.1268	0.2376	0.1110	0.0514	-1.0608*	0.0981	0.0337	0.1167	0.0576	0.0831
β_{SMB}	2.0068***	0.6187***	0.7337***	0.4511***	0.2940**	0.7334**	0.1277	0.5234***	1.0390***	0.7546***	0.5326***
β_{SMB*DY}	-3.9600	0.1062	4.2269**	1.1297**	0.0061	-0.6153	0.2741	0.4257	0.9347**	1.0786**	0.7245
β_{SMB*TB}	-0.9451	-0.1368	1.0166	0.0825	-0.2104	0.1228	-0.1454	0.3373	-0.0969	0.2170	-0.1214
β_{HML}	-0.8532	-0.2759*	0.5797*	0.4097**	-0.1112	-1.5319**	-0.0892	-0.1628	-0.0452	0.0709	-0.0437
β_{HML*DY}	2.0019	-0.6517	1.8481	-0.6848	-0.4451	-10.7707***	-0.4454	1.2431	-0.4192	-0.6125	-1.1476***
β_{HML*TB}	4.8163*	0.6467	-1.8407	0.6552	0.3628	5.5807***	0.1501	0.5461	0.4352	0.8663**	0.1678
β_{CMA}	2.5187	0.0961	0.0182	-0.4240	-0.0294	3.3790***	0.0518	0.0714	-0.0231	-0.6457***	-0.2583
β_{CMA*DY}	3.0504	2.3317	3.8590	0.7035	0.7301	11.4132***	0.7622	1.6120	0.7433	1.4232**	1.8482***
β_{CMA*TB}	-7.3268	-0.6192	4.0343	-0.3669	0.0775	-9.4772***	0.1328	-0.6025	0.0071	0.1053	0.6820
β_{RMW}	2.5106**	0.2748	0.0932	0.1439	0.0400	0.8120	0.2567	0.1923	0.4510**	0.3434	0.2074
β_{RMW*DY}	7.3462	-1.9603	-0.6842	-0.2940	-0.9080*	1.0304	0.2561	-1.7727	0.5772	0.8552	-0.2952
β_{RMW*TB}	-1.0974	-0.0844	0.1087	-0.2988	0.0772	1.4854	0.4175	0.3692	-0.4957	0.1703	-0.2020
Adj. R^2	0.9038	0.8744	0.7660	0.7834	0.8092	0.9337	0.8259	0.8417	0.8562	0.8927	0.8668
w1	0.0027	0.5813	0.0005	0.9245	0.3429	0.1170	0.5306	0.2144	0.7725	0.6624	0.6352
w2	0.0435	0.2979	0.0106	0.1897	0.0000	0.0002	0.6961	0.3141	0.0139	0.0119	0.0000
w3	0.0001	0.1158	0.0000	0.1946	0.0000	0.0001	0.7347	0.2350	0.0244	0.0152	0.0000

Appendix 17. (continued)

	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21
α_p	-0.0074**	-0.0062**	-0.0056***	-0.0045*	0.0003	-0.0023	-0.0071*	-0.0042**	-0.0010	-0.0053***
α_{DY}	0.0147	-0.0107	-0.0195*	-0.0149	-0.0116*	-0.0185	-0.0733**	-0.0121	0.0455	0.0167
α_{TB}	0.0190	-0.0042	-0.0026	-0.0070	0.0005	-0.0002	0.0096	-0.0032	0.0010	0.0059
β_{MKT}	1.1769***	1.2617***	1.1082***	1.2827***	0.9921***	1.0782***	1.2369***	1.0350***	1.0767***	1.0013***
β_{MKT*DY}	0.9938**	0.9739**	0.7639***	0.5832**	0.4380***	0.6123***	1.5286**	0.6565***	0.9693	0.3499
β_{MKT*TB}	-0.1462	0.0763	0.1707	0.3996***	0.1580**	0.2599**	-0.0069	0.4476***	0.0349	0.1216
β_{SMB}	0.9546***	0.9070***	0.6324***	0.6718***	0.5943***	0.8361***	0.8521***	0.2677**	0.6251***	0.4896***
β_{SMB*DY}	-0.1688	2.2704***	1.0376***	1.4124**	0.8483**	0.9412**	0.4109	0.2425	0.0508	-1.1792
β_{SMB*TB}	2.2038*	0.8203**	-0.0057	-0.3873	-0.0482	0.2306	0.8807	0.4419*	-0.6773	-0.3462
β_{HML}	0.3021	0.2622	-0.0344	-0.0655	0.0460	-0.0871	0.3261	0.4804***	-0.0455	-0.1132
β_{HML*DY}	-1.9463	-1.3373*	-1.2325***	-0.4245	-0.2544	-0.7613	-0.8749	-0.8119	-1.1624	-1.8590
β_{HML*TB}	-1.2365	2.0047***	0.3454	-0.0011	0.3823*	0.9206**	-2.5386	0.6765**	0.2545	1.6088**
β_{CMA}	0.1235	-0.7199**	-0.0216	0.5133*	-0.0471	-0.6035***	-1.0505**	-1.0027***	0.5099	0.4178
β_{CMA*DY}	5.1547**	1.3157	1.4228**	0.8288	0.5903	2.0173***	3.0175	2.5994***	5.7256*	2.7712*
β_{CMA*TB}	1.9544	-0.7285	0.3046	0.8184	0.1340	0.2009	6.1394**	0.5338	0.0285	-2.5094**
β_{RMW}	-0.3345	0.2827	0.2555	0.1261	0.2265	0.0195	-0.4528	0.9737***	-0.2946	0.3925**
β_{RMW*DY}	-4.4868*	0.9108	0.8306	1.0202	0.8252*	0.6998	3.4702	1.0418	-4.6471	-2.0969
β_{RMW*TB}	1.2499	0.2773	-0.7008	-0.2319	-0.3313	-0.2093	0.8443	0.4114	1.0425	0.0263
Adj. R^2	0.8218	0.7830	0.8789	0.8442	0.8799	0.7819	0.7329	0.7664	0.7400	0.9544
w1	0.2548	0.8205	0.2143	0.2384	0.1202	0.3474	0.0578	0.3936	0.2421	0.2101
w2	0.0051	0.0002	0.0000	0.0012	0.0023	0.0000	0.1931	0.0000	0.5512	0.1212
w3	0.0048	0.0000	0.0000	0.0011	0.0054	0.0000	0.2263	0.0000	0.3772	0.0741

Appendix 18. Individual performance results of black mutual funds using the conditional five-factor model (FTSE All-World Mining Index)

The table reports individual estimates of European black mutual funds, considering the period December 2003 to November 2019.The results are obtained by the regression of the conditional five-factor model (eq. 4), using FTSE All-World Mining Index. Additionally, it presents the performance estimates (α_p), the conditional alphas coefficients (α_{DY}, α_{TB}), the systematic risk (β_{MKT}), the conditional beta estimates (β_{MKT*DY}, β_{MKT*TB}, β_{SMB*DY}, β_{SMB*TB}, β_{HML*DY}, β_{CMA*DY}, β_{CMA*TB}, β_{RMW*DY} and β_{RMW*TB}), the regression coefficients of size (SMB), book-to-market (HML), investments (CMA) and profitability (RMW) factors and the adjusted coefficient of determination ($Adj.\ R^2$). The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. w1, w2 and w3 correspond to the probability values from the Wald test on the existence of time-varying alphas, time-varying betas and joint time-varying alphas and betas.

Panel C: FTSE All-World Mining Index

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14
α_p	-0.0031	-0.0002	-0.0052	-0.0011	-0.0049	-0.0015	-0.0075	-0.0041	-0.0013	-0.0060	-0.0035*	-0.0047	0.0002	-0.0051
α_{DY}	-0.0084	-0.0369	0.0170	0.0016	0.0137	-0.0079	0.0039	0.0039	-0.0042	-0.0862	-0.0018	0.0227	-0.0078	0.0268
α_{TB}	-0.0071	-0.0036	-0.0106	-0.0007	-0.0065	-0.0076	0.0151	0.0037	-0.0054	0.0117	-0.0044	-0.0102	-0.0066	-0.0106
β_{MKT}	0.7436***	0.3648***	0.9763***	0.8149***	0.9871***	0.4899***	0.9845***	0.5613***	0.6717***	0.3272***	0.7436***	0.9914***	0.5835***	0.9540***
β_{MKT*DY}	0.3047**	0.6547	0.2697	0.0462	0.3479	0.1548	0.0106	-0.0646	0.3516***	0.8519	0.2110**	0.2759	0.2424	0.2043
β_{MKT*TB}	0.0542	-0.1343	0.0565	0.0823**	0.0328	0.1241	-0.4197	-0.0825	0.0907	0.1262	0.1729***	0.1299	0.0316	-0.0102
β_{SMB}	0.2489	-0.3650	0.8787**	-0.0774	0.9779***	-0.2452	1.3459***	-0.0735	0.2255	-0.7804	0.2200*	1.2738***	0.0911	1.0428***
β_{SMB*DY}	0.4302	-0.6083	0.4166	-0.3866	0.8186	-0.1078	0.2954	-1.2838	0.4427	2.5587	0.1269	0.6179	0.4868	0.4465
β_{SMB*TB}	-0.0886	1.1008	-0.6653	0.1147	-0.9023	0.9846	-0.1439	-1.2285	-0.6107**	2.5086	-0.4169**	-0.8681	0.0818	-0.7972
β_{HML}	0.2350	1.0165*	-0.8958**	0.2668***	-0.7850**	0.9415***	-0.6700	0.8539**	0.4116**	1.3469**	0.1095	-0.8886**	0.4422**	-0.9084**
β_{HML*DY}	-0.6870	5.0114	-1.0600	-0.3744	-1.3378	3.7030	-0.0716	-0.1428	-1.0921***	3.8738	-0.9896**	-1.2976	-0.9696*	-0.9400
β_{HML*TB}	0.3496	-2.5060	0.2331	-0.0416	0.1374	-1.0742	2.2697	0.1588	0.1908	-3.5188	-0.0353	-0.1505	0.4441	0.1511
β_{CMA}	-0.2688	-1.8091*	0.0652	-0.2638**	0.2591	-1.1675**	0.5141	-1.2760**	-1.0589***	-2.3779**	-0.6761***	0.2066	-1.3157***	0.2972
β_{CMA*DY}	2.7092***	-12.0684**	5.3640***	0.7798*	5.8560***	-9.7826***	4.4246*	-2.8778	2.7600***	-12.0781**	2.1277***	5.5535***	2.6421**	5.4611***
β_{CMA*TB}	0.4167	3.1190	0.6301	0.5715**	0.7715	1.2732	2.4752	-2.0317	0.6225	4.9447	0.9564**	1.4420	0.0157	0.6389
β_{RMW}	0.2921	-0.0385	0.4150	-0.0088	0.3185	0.2475	1.3922*	-1.2867**	-0.0277	0.5478	-0.1275	0.1490	-0.4038	0.3416
β_{RMW*DY}	0.6137	7.4798	1.6709	-0.3259	1.5070	3.5292	2.5336	-2.6614*	-0.0850	8.5528	-0.4634	0.8370	-0.1049	1.2351
β_{RMW*TB}	0.8413	-2.7117	2.8555***	-0.1914	1.8704*	-0.5893	5.8639**	-1.8693	0.1613	-2.3343	-0.0016	2.4946**	0.2804	2.8385**
Adj. R^2	0.8296	0.5143	0.6261	0.9624	0.6495	0.7387	0.5805	0.6246	0.8004	0.4825	0.9039	0.6503	0.7725	0.6151
w1	0.5484	0.8761	0.3274	0.8718	0.5679	0.8513	0.8507	0.9707	0.5512	0.4950	0.4789	0.2483	0.2302	0.1867
w2	0.1255	0.6136	0.0068	0.0591	0.0055	0.0109	0.0610	0.4288	0.0008	0.4204	0.0093	0.0167	0.0000	0.0037
w3	0.2032	0.5520	0.0091	0.1170	0.0070	0.0016	0.1101	0.5247	0.0000	0.5311	0.0195	0.0201	0.0000	0.0041

Appendix 18. (continued)

	F15	F16	F17	F18	F19	F20	F21	F22	F23	F24	F25	F26	F27	F28
α_p	-0.0005	-0.0041	-0.0030	-0.0193*	-0.0024	-0.0006	0.0039	-0.0019	-0.0005	-0.0044	-0.0032	-0.0035	-0.0010	-0.0004
α_{DY}	-0.0021	0.0297	0.0036	-0.1752*	-0.0010	-0.0083	0.0464	0.0028	0.0011	0.0214	-0.0139	-0.0532	0.0028	0.0335
α_{TB}	-0.0062	-0.0083	-0.0143	0.0059	-0.0005	-0.0063	-0.0432*	-0.0033	-0.0032	-0.0131	-0.0164	0.0090	0.0018	-0.0106
β_{MKT}	0.5975***	0.9383***	1.0396***	0.4366***	0.9259***	0.6380***	1.1505***	0.8962***	0.4308***	0.9968***	0.8366***	0.4203***	0.4792***	0.6965***
β_{MKT*DY}	0.2974*	0.2252	0.0695	-0.0413	0.1594	0.2459	0.0268	0.0815	0.2058	0.2391	0.2518	0.8954*	0.2066	0.1064
β_{MKT*TB}	-0.0123	0.0011	-0.2914	0.2543	0.1455**	-0.0040	0.2748	0.4028**	0.1499	0.0463	0.4624**	-0.5446	0.1687	-0.6548**
β_{SMB}	0.2724	0.7595**	1.2814***	0.6247	0.1501	-0.1593	1.9111***	1.2942***	-0.0427	0.7536**	0.8058*	-0.2461	0.0219	0.1277
β_{SMB*DY}	0.4372	0.9894	0.2246	5.6319	0.5444	0.3610	0.7183	0.0253	-0.8190	0.3790	1.1093	-1.0610	-1.1171	0.0159
β_{SMB*TB}	-0.2400	-0.6331	0.2474	-0.4589	-0.5846***	-0.4906	0.7543	-0.8091	0.1557	-1.3293**	-0.3879	0.7556	-0.3045	0.8397
β_{HML}	0.6102***	-0.8527**	-0.6006	0.6673	0.4802***	0.5082**	-0.5271	-0.0525	0.9201***	-0.8002**	-0.7859*	1.0925**	0.8027***	0.2223
β_{HML*DY}	-1.3098**	-1.2980	-0.9374	-2.1290	-0.9333**	-1.0127*	-1.0073	-1.4748	-0.6284	-1.0891	0.2816	-0.2606	-1.4338*	0.4082
β_{HML*TB}	0.2917	0.0850	2.4615	-1.0318	-0.5894**	0.0817	1.8436	-0.9460	-0.2036	0.6041	-0.7210	-4.1366*	-0.2057	0.6651
β_{CMA}	-1.4627***	0.6892	0.2792	-1.0592	-0.7017**	-1.6129***	0.0023	-0.9022*	-0.8001**	0.2451	1.2916*	-1.6248**	-1.0342**	-0.5668
β_{CMA*DY}	3.0255***	4.5930**	4.8816*	-19.6420**	0.5636	0.7516	6.4541**	1.9335	1.9507*	3.8005**	3.6287*	-12.8412**	1.2201	-2.2084
β_{CMA*TB}	0.3438	0.6512	0.9599	-0.8397	0.6331	-0.3298	3.2237	3.2082***	1.3866*	-0.2321	2.9157*	4.6360	1.0921	-1.9479
β_{RMW}	-0.2304	0.4838	1.3959*	1.0089	-0.2363	-0.7534***	1.0762	-0.6773	0.0689	0.1975	0.8370	0.7884	-0.3583	0.0781
β_{RMW*DY}	-0.6444	0.8047	1.8607	18.2402	-1.2084	-1.5562*	0.9152	-0.9374	-1.2650	0.5790	1.5595	3.8463	-2.0538	-1.0063
β_{RMW*TB}	0.3023	2.6455**	3.8856	-3.4776	-1.1397***	-0.8064	7.4198***	-0.6282	-0.9033	2.7044**	1.7138	-5.6049*	-1.0197	-0.8791
Adj. R^2	0.7871	0.5654	0.6168	0.1819	0.9162	0.8139	0.6812	0.8146	0.5590	0.6109	0.5096	0.4454	0.5648	0.7555
w1	0.5051	0.2478	0.8634	0.2080	0.9839	0.4852	0.0194	0.8994	0.8677	0.2018	0.4942	0.6246	0.9683	0.3013
w2	0.0120	0.0548	0.0681	0.2188	0.0000	0.1759	0.0299	0.0293	0.3026	0.0068	0.3811	0.0452	0.3456	0.4566
w3	0.0176	0.0443	0.0335	0.3389	0.0000	0.1087	0.0057	0.0638	0.4002	0.0072	0.5375	0.0799	0.5064	0.3409

Appendix 19. Individual results of green mutual funds using the conditional Carhart (1997) four-factor model including a dummy variable for expansion and recession periods (FTSE All-World Index)

The table reports individual results of European green mutual funds, considering the period December 2003 to November 2019. The results are obtained by the regression of the multifactor model of Carhart (1997) including a dummy variable to distinguish between expansion and recession periods (eq. 5), using FTSE All-World Index as the market proxy. D_t refers to the dummy variable that takes a value of 0 in expansion periods and a value of 1 in recession periods. Additionally, it presents the performance estimates in non-crisis periods ($\alpha_{0,p}$), the alpha coefficient for crisis periods ($\alpha_{rec,p} \times D_t$), the beta coefficients β_{MKT}, β_{SMB}, β_{HML}, and β_{MOM}, represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML) and momentum (MOM) factors for non-crisis periods and the coefficients $\beta_{MKT} \times D_t$, $\beta_{SMB} \times D_t$, $\beta_{HML} \times D_t$, and $\beta_{MOM} \times D_t$ represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML) and momentum (MOM) factors for the crisis periods. The $Adj.\ R^2$ refers to the adjusted coefficient of determination.

The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. Funds F1, F6, F20, and F21 were excluded from this analysis, due to missing data for the recession periods.

Panel A: FTSE All-World Index

	$\alpha_{0,p}$	$\alpha_{rec,p} \times D_t$	β_{MKT}	$\beta_{MKT} \times D_t$	β_{SMB}	$\beta_{SMB} \times D_t$	β_{HML}	$\beta_{HML} \times D_t$	β_{MOM}	$\beta_{MOM} \times D_t$	Adj. R^2
F2	-0.0043***	-0.0007	1.0323***	0.0287	0.4098***	0.0022	-0.3164***	0.3068	-0.0115	0.2082	0.8972
F3	-0.0057**	0.0029	1.1335***	-0.2602	0.5881***	-0.5926	0.3412**	-0.2303	-0.2215*	0.0360	0.7823
F4	-0.0049*	-0.0034	1.0726***	0.0275	0.1733	0.9466**	0.2264	0.1757	0.0759	0.0133	0.7853
F5	-0.0055***	0.0023	0.9049***	0.0610	0.1319	0.1577	-0.1030	0.1782	0.0142	0.1623	0.8000
F7	-0.0015	-0.0049	0.9938***	-0.0450	-0.1829	0.6526**	0.0094	0.0669	0.0978	-0.0760	0.8268
F8	-0.0057***	0.0012	1.0495***	-0.0128	0.2863***	0.3056	-0.2601***	0.5225	0.0146	0.0612	0.8441
F9	-0.0002	-0.0012	1.0489***	-0.0585	0.7741***	0.2966	-0.0782	-0.3203	0.0610	-0.0425	0.8644
F10	-0.0029	-0.0064	1.2565***	0.1287	0.4233***	0.6895**	-0.1989	-0.2580	0.0890	-0.0937	0.8999
F11	-0.0057***	-0.0035	1.1382***	-0.0085	0.2434**	0.4394	-0.0013	-0.4637	0.2312***	-0.3393***	0.8840
F12	-0.0084***	0.0135	1.2491***	0.0039	0.9197***	-0.4194	0.4446**	-0.9944*	0.0677	-0.6192	0.8030
F13	-0.0066**	-0.0026	1.2972***	0.1298	0.5123**	0.9904**	0.1948	-0.7063	0.3944**	-0.3822*	0.7687
F14	-0.0044**	-0.0010	1.1264***	0.1502**	0.4423***	0.3910*	0.0589	-0.3813	0.0801	0.1261	0.8969
F15	-0.0034	0.0026	1.2051***	0.0947	0.3560**	0.9702***	0.3041**	-0.3243	0.1268	0.0655	0.8389
F16	0.0007	0.0014	0.9881***	0.0871	0.4042***	0.3866*	0.0382	-0.2681	-0.0042	0.0878	0.8975
F17	-0.0014	-0.0071	1.1678***	-0.0100	0.6833***	0.6317*	-0.2045	-0.2110	0.1133	0.1441	0.7916
F18	-0.0050	-0.0142	1.3488***	0.1737	0.8326***	0.8135	0.1096	0.1825	-0.0398	-0.0890	0.7194
F19	0.0006	-0.0078	1.0584***	-0.0311	0.1588	-0.3253	-0.0107	-0.5777**	0.0916	0.0344	0.7398

Appendix 20. Individual results of black mutual funds using the conditional Carhart (1997) four-factor model including a dummy variable for expansion and recession periods (FTSE All-World Index)

The table reports individual results of European black mutual funds, considering the period December 2003 to November 2019. The results are obtained by the regression of the multifactor model of Carhart (1997) including a dummy variable to distinguish between expnasion and recession periods (eq. 5), using FTSE All-World Index as the market proxy. D_t refers to the dummy variable that takes a value of 0 in expansion periods and a value of 1 in recession periods. Additionally, it presents the performance estimates in non-crisis periods ($\alpha_{0,p}$), the alpha coefficient for crisis periods ($\alpha_{rec,p} \times D_t$), the beta coefficients β_{MKT}, β_{SMB}, β_{HML}, and β_{MOM}, represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML) and momentum (MOM) factors for non-crisis periods and the coefficients $\beta_{MKT} \times D_t$, $\beta_{SMB} \times D_t$, $\beta_{HML} \times D_t$, and $\beta_{MOM} \times D_t$ represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML) and momentum (MOM) factors for the crisis periods. The $Adj.\ R^2$ refers to the adjusted coefficient of determination.

The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. Funds F2, F10, F18, and F26 were excluded from this analysis, due to the missing data for recession periods.

Panel A: FTSE All-World Index

	$\alpha_{0,p}$	$\alpha_{rec,p} \times D_t$	β_{MKT}	$\beta_{MKT} \times D_t$	β_{SMB}	$\beta_{SMB} \times D_t$	β_{HML}	$\beta_{HML} \times D_t$	β_{MOM}	$\beta_{MOM} \times D_t$	Adj. R^2
F1	-0.0042	-0.0044	1.0125***	0.1705	0.6503*	0.0531	0.2618	-1.7389***	0.0071	0.1916	0.4630
F3	-0.0006	-0.0164	0.6084***	0.3765	1.0580*	1.0884	-0.0997	-2.0236*	0.4896	-0.3934	0.1402
F4	-0.0028	-0.0085	1.2146***	0.0264	0.3748	-0.3684	0.6828***	-2.2344***	0.3256*	-0.3564	0.5696
F5	-0.0012	-0.0127	0.6748***	0.3950	1.1711**	1.0600	0.0957	-2.3448**	0.4820	-0.3090	0.1622
F6	-0.0065*	0.0122	1.1068***	-0.4831	0.4749**	-0.1346	0.7926***	-1.4653	-0.0794	-1.2998	0.6507
F7	-0.0006	-0.0193	0.4472*	0.4904	1.2556*	-0.0081	-0.2846	-1.5034	0.0174	-0.1184	0.0390
F8	-0.0155***	0.0121	1.3189***	0.0066	1.0711***	-1.0132	0.6040**	-2.1531***	-0.3959*	0.2120	0.6982
F9	-0.0042	-0.0068	1.1879***	0.1510	0.6129**	0.7425	0.4305*	-2.2595***	0.2689	-0.0731	0.5740
F11	-0.0056	-0.0100	1.1333***	0.0639	0.6245**	0.3467	0.4753*	-2.5118***	0.4037**	-0.4205	0.5555
F12	-0.0020	-0.0163	0.8115***	0.2576	1.5245***	1.0047	-0.0784	-2.0894*	0.3902	-0.3055	0.1983
F13	-0.0042	-0.0043	1.1119***	0.0631	0.5322**	0.1428	0.4140*	-1.8620***	0.2502	-0.0698	0.5652
F14	-0.0012	-0.0150	0.6149***	0.2920	1.1194**	1.2880	-0.1366	-1.6324	0.4407	-0.3706	0.1356
F15	-0.0047	-0.0064	1.1436***	0.1927	0.6628**	0.4318	0.4845**	-2.2032***	0.2728	-0.1150	0.5934
F16	0.0006	-0.0138	0.6135***	0.2889	0.8112	1.2747	-0.0667	-1.8801*	0.2639	-0.2577	0.1145
F17	0.0011	-0.0001	0.6000**	-0.1480	1.4023*	-0.9551	-0.1235	-2.2230**	0.1680	-0.6014	0.0487
F19	-0.0048	-0.0125	1.5074***	-0.0017	0.6932**	0.6055	0.6968**	-2.8134***	0.1166	-0.2765	0.6046
F20	-0.0066**	-0.0074	1.3341***	0.1128	0.3524	0.7255	0.3431*	-2.2487***	0.1791	-0.2438	0.6755
F21	0.0026	-0.0089	0.7981***	0.1944	2.0712**	0.2557	-0.4682	-2.4583*	-0.1812	-0.1938	0.1739
F22	-0.0057	-0.0191	1.4082***	0.0365	2.0775***	0.1622	0.4377	-3.6749***	0.3529	-0.7608*	0.5731
F23	-0.0053*	0.0039	1.1069***	-0.0078	0.3992**	-1.2021**	0.8026***	-1.8771***	0.1803	-0.1023	0.6594
F24	0.0003	-0.0131	0.6639***	0.3178	0.9537*	1.8971	0.0051	-2.3445**	0.2310	-0.1742	0.1435
F25	0.0022	-0.0160	0.4862**	0.1409	0.9788*	0.5312	-0.1844	-0.6605	-0.0641	0.0507	0.0796
F27	-0.0069**	0.0002	1.2832***	-0.0180	0.5448**	-0.7139	0.8144***	-2.5392***	0.2070	-0.2132	0.6946
F28	-0.0076**	-0.0066	1.1412***	-0.1420	0.9588***	-1.2875	-0.0699	-0.2892	-0.3720**	-0.3379	0.6298

Appendix 21. Individual results of green mutual funds using the conditional Carhart (1997) four-factor model including a dummy variable for expansion and recession periods (FTSE4GOOD Global Index)

The table reports individual results of European green mutual funds, considering the period December 2003 to November 2019. The results are obtained by the regression of the multifactor model of Carhart (1997) including a dummy variable to distinguish between expansion and recession periods (eq. 5), using FTSE4GOOD Global Index as the market proxy. D_t refers to the dummy variable that takes a value of 0 in expansion periods and a value of 1 in recession periods. Additionally, it presents the performance estimates in non-crisis periods ($\alpha_{0,p}$), the alpha coefficient for crisis periods ($\alpha_{rec,p} \times D_t$), the beta coefficients β_{MKT}, β_{SMB}, β_{HML}, and β_{MOM}, represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML) and momentum (MOM) factors for non-crisis periods and the coefficients $\beta_{MKT} \times D_t$, $\beta_{SMB} \times D_t$, $\beta_{HML} \times D_t$, and $\beta_{MOM} \times D_t$ represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML) and momentum (MOM) factors for the crisis periods. The $Adj.\ R^2$ refers to the adjusted coefficient of determination.

The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. Funds F1, F6, F20, and F21 were excluded from this analysis, due to missing data for the recession periods.

Panel B: FTSE4GOOD Global Index											
	$\alpha_{0,p}$	$\alpha_{rec,p} \times D_t$	β_{MKT}	$\beta_{MKT} \times D_t$	β_{SMB}	$\beta_{SMB} \times D_t$	β_{HML}	$\beta_{HML} \times D_t$	β_{MOM}	$\beta_{MOM} \times D_t$	Adj. R^2
F2	-0.0050***	0.0013	1.0260***	-0.0152	0.5352***	-0.0320	-0.3233***	0.0701	-0.0115	0.1495	0.8784
F3	-0.0060**	0.0003	1.0856***	-0.2016	0.7034***	-0.4759	0.3242*	-0.2028	-0.2489*	0.1921	0.7368
F4	-0.0046**	-0.0044	1.0478***	0.0529	0.3267**	0.9370**	0.2022	-0.0918	0.1251	-0.0410	0.7801
F5	-0.0059***	0.0020	0.8969***	0.0767	0.2939**	0.1242	-0.1486	-0.0336	0.0259	0.1517	0.8075
F7	-0.0013	-0.0058	0.9788***	-0.0174	-0.0298	0.6274**	-0.0165	-0.1610	0.1444	-0.1177	0.8337
F8	-0.0064***	0.0021	1.0503***	-0.0234	0.4155***	0.3088	-0.2655**	0.3074	0.0174	0.0443	0.8410
F9	0.0003	-0.0025	1.0097***	-0.0180	0.9204***	0.2801	-0.0825	-0.5787**	0.1189	-0.1044	0.8427
F10	-0.0025	-0.0078*	1.2122***	0.1750*	0.6114***	0.6829**	-0.2298*	-0.5947**	0.1426	-0.1527	0.8817
F11	-0.0054***	-0.0047	1.0954***	0.0331	0.4134***	0.4166	-0.0301	-0.7341***	0.2783***	-0.3931***	0.8629
F12	-0.0088***	0.0158	1.2234***	-0.0406	1.1422***	-0.5461	0.4051**	-1.2475**	0.0746	-0.7074*	0.8036
F13	-0.0060**	-0.0043	1.2457***	0.1748	0.6929***	0.9941**	0.1904	-1.0789***	0.4661***	-0.4661**	0.7460
F14	-0.0040**	-0.0023	1.0802***	0.1976**	0.6099***	0.3904	0.0334	-0.6943*	0.1280	0.0727	0.8410
F15	-0.0032	0.0015	1.1605***	0.1659	0.5431***	0.9611**	0.2684	-0.6380**	0.1722	0.0340	0.8290
F16	0.0012	0.0001	0.9448***	0.1461**	0.5414***	0.3946*	0.0361	-0.5538***	0.0505	0.0396	0.8749
F17	-0.0008	-0.0085*	1.1159***	0.0544	0.8455***	0.6246**	-0.2068	-0.5178	0.1780	0.0831	0.7675
F18	-0.0055	-0.0123	1.3195***	0.1517	1.0545***	0.7454	0.0774	-0.1256	-0.0288	-0.1614	0.7104
F19	0.0012	-0.0092*	1.0000***	0.0165	0.3050*	-0.3406	-0.0092	-0.8495**	0.1506	-0.0379	0.6974

Appendix 22. Individual results of black mutual funds using the conditional Carhart (1997) four-factor model including a dummy variable for expansion and recession periods (FTSE All-World Mining Index)

The table reports individual results of European black mutual funds, considering the period December 2003 to November 2019. The results are obtained by the regression of the multifactor model of Carhart (1997) including a dummy variable to distinguish between expnasion and recession periods (eq. 5), using FTSE All-World Mining Index as the market proxy. D_t refers to the dummy variable that takes a value of 0 in expansion periods and a value of 1 in recession periods. Additionally, it presents the performance estimates in non-crisis periods ($\alpha_{0,p}$), the alpha coefficient for crisis periods ($\alpha_{rec,p} \times D_t$), the beta coefficients β_{MKT}, β_{SMB}, β_{HML}, and β_{MOM}, represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML) and momentum (MOM) factors for non-crisis periods and the coefficients $\beta_{MKT} \times D_t$, $\beta_{SMB} \times D_t$, $\beta_{HML} \times D_t$, and $\beta_{MOM} \times D_t$ represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML) and momentum (MOM) factors for the crisis periods. The $Adj.\ R^2$ refers to the adjusted coefficient of determination.
The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. Funds F2, F10, F18, and F26 were excluded from this analysis, due to the missing data for recession periods.

Panel C: FTSE All-World Mining Index											
	$\alpha_{0,p}$	$\alpha_{rec,p} \times D_t$	β_{MKT}	$\beta_{MKT} \times D_t$	β_{SMB}	$\beta_{SMB} \times D_t$	β_{HML}	$\beta_{HML} \times D_t$	β_{MOM}	$\beta_{MOM} \times D_t$	Adj. R^2
F1	-0.0024	0.0048	0.7481***	0.0451	0.3444*	-0.2040	-0.0068	-0.1768	-0.1408	0.3119**	0.8261
F3	-0.0041	-0.0002	0.9404***	-0.0700	0.6487*	0.9364	-0.8814**	0.2033	0.0181	0.2887	0.5756
F4	-0.0009	0.0014	0.8287***	0.0118	0.0585	-0.6464***	0.1955**	-0.3755**	-0.0354	-0.0149	0.9632
F5	-0.0043	0.0036	0.9505***	-0.0377	0.7613**	0.8745	-0.6766*	-0.0598	0.0102	0.3553	0.5988
F6	-0.0005	0.0265	0.4936***	-0.6477	-0.0293	0.9704	0.1913	-1.3658	-0.3470**	-1.9544	0.7211
F7	-0.0031	-0.0094	0.9364***	0.2174	0.8279*	0.7406	-0.8692**	0.1942	0.0686	0.4602	0.5384
F8	-0.0081	0.0149	0.5834***	0.1448	0.6519*	-1.2864	0.5774*	-0.9763	-0.4773*	0.0716	0.6162
F9	-0.0016	0.0019	0.7117***	0.1208*	0.3507**	0.3961	0.0549	-0.5343	-0.0296	0.1216	0.7857
F11	-0.0039**	-0.0007	0.7686***	0.0293	0.3316**	0.0719	0.0252	-0.7612***	0.0693	-0.1193	0.8979
F12	-0.0044	-0.0012	0.9810***	-0.0985	1.1091***	0.8383	-0.8413**	0.1331	-0.0875	0.3316	0.6104
F13	-0.0013	0.0037	0.6219***	0.1599**	0.3079*	-0.1895	0.1078	-0.2816	-0.0047	0.1510	0.7538
F14	-0.0046	0.0000	0.9220***	-0.1150	0.7192*	1.1689	-0.8976**	0.4691	-0.0201	0.2903	0.5550
F15	-0.0017	0.0028	0.6344***	0.2429***	0.4347**	0.0322	0.1749	-0.4653	0.0135	0.0924	0.5549
F16	-0.0026	0.0007	0.9026***	-0.1176	0.4202	1.1569	-0.8081**	0.1636	-0.1862	0.3715	0.5142
F17	-0.0005	0.0026	0.9964***	0.0926	0.9289*	0.2616	-0.7054	-0.8858	0.2090	0.2301	0.5549
F19	-0.0020	-0.0016	0.9703***	0.0181	0.3284*	0.2630	0.1515	-0.6589**	-0.2993**	0.0809	0.9150
F20	-0.0026	0.0016	0.6773***	0.2608***	0.1162	0.2871	0.0461	-0.4258	-0.0886	-0.0453	0.7878
F21	0.0014	0.0106	1.1898***	-0.2378	1.4940***	0.4084	-1.1364**	-0.3693	-0.1411	0.1794	0.6199
F22	-0.0036	-0.0083	0.9540***	-0.0184	1.6499***	-0.0833	0.1220	-1.8375***	0.1495	-0.6278**	0.8004
F23	-0.0010	0.0080	0.4529***	0.1679**	0.2553	-1.5302***	0.6678***	-0.7442	0.0185	-0.0953	0.5694
F24	-0.0031	0.0021	0.9673***	-0.1435	0.5351	1.7754*	-0.7876**	-0.1879	-0.2510	0.4691	0.5656
F25	0.0011	-0.0074	0.8167***	-0.2997	0.4905	0.6785	-0.6195	0.6296	-0.0664	0.1459	0.4779
F27	-0.0019	0.0039	0.5144***	0.1462	0.3831*	-1.0717	0.6691***	-1.3399**	0.0254	-0.2699	0.5664
F28	-0.0029	0.0077	0.6599***	-0.1616	0.3551	-1.3679*	-0.3095	-0.2135	-0.3608**	-0.4224	0.7591

Appendix 23. Individual results of green mutual funds for the of Fama and French (2015) model including a dummy variable for expansion and recession periods (FTSE All-World Index)

The table reports individual estimation of European green mutual funds, considering the period December 2003 to November 2019. The results are obtained by the regression of the Fama and French (2015) five-factor model including a dummy variable to distinguish between expansion and recession periods (eq. 6), using FTSE All-World Index as the market proxy. D_t refers to the dummy variable that takes a value of 0 in expansion periods and a value of 1 in recession periods. Additionally, it presents the performance estimates in non-crisis periods ($\alpha_{0,p}$), the alpha coefficient for crisis periods ($\alpha_{rec,p} \times D_t$), the beta coefficients β_{MKT}, β_{SMB}, β_{HML}, $\beta_{CMA,}$ and β_{RMW}, represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML)), investment (CMA) and profitability (RMW) factors for non-crisis periods and the coefficients $\beta_{MKT}\times D_t$, $\beta_{SMB}\times D_t$, $\beta_{HML}\times D_t$, $\beta_{CMA}\times D_t$ and $\beta_{RMW}\times D_t$ represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML)), investment (CMA) and profitability (RMW) factors for the crisis periods. The $Adj.\ R^2$ refers to the adjusted coefficient of determination.
The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. Funds F1, F6, F20, and F21 were excluded from this analysis, due to missing data for the recession periods.

Panel A: FTSE All-World Index

	$\alpha_{0,p}$	$\alpha_{rec,p} \times D_t$	β_{MKT}	$\beta_{MKT} \times D_t$	β_{SMB}	$\beta_{SMB} \times D_t$	β_{HML}	$\beta_{HML} \times D_t$	β_{CMA}	$\beta_{CMA} \times D_t$	β_{RMW}	$\beta_{RMW} \times D_t$	Adj. R^2
F2	-0.0043***	-0.0023	1.0276***	0.2213	0.3972***	0.3739	-0.2852***	0.8983	-0.0614	-0.1280	-0.0094	1.5552*	0.8991
F3	-0.0064**	0.0029	1.2119***	-0.4055	0.6155***	-0.7903	0.3660*	-0.6232	0.3490	-0.1625	-0.0427	-0.8746	0.7718
F4	-0.0046*	-0.0006	1.0708***	-0.1502	0.1848	0.6692	0.1873	0.2572	-0.0425	-0.4041	-0.0031	-0.4322	0.7829
F5	-0.0057***	0.0025	0.9106***	-0.0156	0.1495	-0.0882	-0.1202	-0.3337	0.0559	0.1918	0.0520	-0.7607	0.7972
F7	-0.0023	-0.0019	1.0468***	-0.1752	-0.0697	0.3675	-0.2191	0.1154	0.5698**	-0.6730*	0.2549	-0.9254*	0.8338
F8	-0.0059***	-0.0046	1.0447***	0.2122	0.2993***	0.5816	-0.1986	0.6059	-0.1150	0.7372	0.0928	0.8271	0.8454
F9	-0.0007	-0.0051	1.0698***	0.0648	0.8296***	0.4918*	-0.1145	-0.2449	0.1230	0.2835	0.1950	0.6904	0.8673
F10	-0.0023	-0.0069	1.2404***	0.1001	0.4091***	0.7601**	-0.2034	0.2213	-0.1935	-0.1885	-0.0541	0.7991*	0.9028
F11	-0.0053***	-0.0038	1.1477***	0.0253	0.2973***	0.5055*	-0.1814	-0.0320	0.0723	-0.1857	0.0813	0.2017	0.8763
F12	-0.0072**	0.0141	1.2371***	-0.0417	0.8613***	-0.4079	0.1619	-0.4836	0.3367	-1.6182	-0.3795	-0.8217	0.8036
F13	-0.0054*	-0.0003	1.2959***	-0.0275	0.6294***	0.6680	0.1193	-0.4391	-0.3479	-0.1922	0.1807	-0.5278	0.7584
F14	-0.0046***	-0.0032	1.1444***	0.1043	0.4911***	0.2711	-0.0294	-0.5259*	0.1625	0.0789	0.1293	0.1213	0.8907
F15	-0.0041*	0.0043	1.2701***	-0.0894	0.4732**	0.5451	-0.0561	-0.5048	0.7855***	-0.6540	0.1801	-1.0889*	0.8440
F16	0.0005	-0.0009	0.9966***	0.1271	0.4176***	0.4362*	0.0206	-0.3681*	0.0878	0.1924	0.0517	0.3027	0.8966
F17	-0.0003	-0.0114**	1.1235***	0.0171	0.6434***	0.5743	-0.0910	-0.7521*	-0.5950**	1.0188**	-0.1586	0.2750	0.7884
F18	-0.0026	-0.0179	1.2615***	0.1406	0.5482*	0.7890	0.1308	-0.6089	-0.5889	1.3626	-0.7920*	-0.5482	0.7307
F19	-0.0022	-0.0059	1.0670***	-0.1050	0.2253	-0.4384	0.4043**	-0.8593**	-0.6741***	0.5393	0.8394***	-0.3539	0.7683

Appendix 24. Individual results of black mutual funds for the Fama and French (2015) model including a dummy variable for expansion and recession periods (FTSE All-World Index)

The table reports individual estimates of European black mutual funds, considering the period December 2003 to November 2019. The results are obtained by the regression of the Fama and French (2015) five-factor model including a dummy variable to distinguish between expansion and recession periods (eq. 6), using FTSE All-World Index as the market proxy. D_t refers to the dummy variable that takes a value of 0 in expansion periods and a value of 1 in recession periods. Additionally, it presents the performance estimates in non-crisis periods ($\alpha_{0,p}$), the alpha coefficient for crisis periods ($\alpha_{rec,p} \times D_t$), the beta coefficients β_{MKT}, β_{SMB}, β_{HML}, $\beta_{CMA,}$ and β_{RMW}, represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML)), investment (CMA) and profitability (RMW) factors for non-crisis periods and the coefficients $\beta_{MKT} \times D_t$, $\beta_{SMB} \times D_t$, $\beta_{HML} \times D_t$, $\beta_{CMA} \times D_t$ and $\beta_{RMW} \times D_t$ represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML)), investment (CMA) and profitability (RMW) factors for the crisis periods. The $Adj.\ R^2$ refers to the adjusted coefficient of determination.

The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. Funds F2, F10, F18, and F26 were excluded from this analysis, due to the missing data for recession periods.

Panel A: FTSE All-World Index

	$\alpha_{0,p}$	$\alpha_{rec,p} \times D_t$	β_{MKT}	$\beta_{MKT} \times D_t$	β_{SMB}	$\beta_{SMB} \times D_t$	β_{HML}	$\beta_{HML} \times D_t$	β_{CMA}	$\beta_{CMA} \times D_t$	β_{RMW}	$\beta_{RMW} \times D_t$	Adj. R^2
F1	-0.0052	0.0023	1.0350***	-0.1734	0.7130*	-0.5751	0.3010	-2.0541**	0.1087	-0.6852	0.3038	-1.6515	0.4584
F3	0.0003	-0.0087	0.5665**	0.1287	1.1474**	0.2787	0.1466	-3.2278**	-1.2118	0.9871	0.3858	-3.4302	0.1424
F4	-0.0028	0.0046	1.2076***	-0.4830**	0.4713	-1.1640*	0.8230***	-1.8162**	-0.6319	-1.1591	0.4235	-1.9885*	0.5803
F5	0.0003	-0.0085	0.6400***	0.1956	1.2640**	0.3376	0.2067	-3.4674**	-0.9515	0.9867	0.2281	-2.7786	0.1577
F6	-0.0069**	-0.0044	1.1927***	-1.4382	0.5781**	-0.4348	0.5996**	-3.0295	0.6657	0.9916	0.0357	-5.9296	0.6527
F7	-0.0038	0.0043	0.5355**	-0.2997	1.5064**	-1.4627	-0.3282	-1.7054	0.7025	-2.3039	0.8650	-5.4883**	0.0612
F8	-0.0150***	0.0248**	1.2802***	-0.3549	0.9051***	-1.4437*	0.9894***	-1.9586***	-0.5417	-1.1000	-0.3653	-1.2329	0.7010
F9	-0.0051	0.0012	1.1520***	-0.2047	0.6532**	0.0763	0.8536***	-2.7565***	-1.1863*	0.3006	0.5558	-1.8482	0.5882
F11	-0.0049	0.0009	1.1046***	-0.3602	0.7069**	-0.3864	0.6394**	-2.3304***	-0.9019	-0.5829	0.3115	-1.9413*	0.5622
F12	-0.0013	-0.0073	0.7761***	-0.0369	1.5921***	0.1533	0.1210	-3.2302**	-0.9841	0.6256	0.2926	-3.5534*	0.2012
F13	-0.0037	0.0011	1.0373***	-0.1728	0.4962**	-0.3790	0.8509***	-2.5988***	-1.4424***	0.8918	0.1818	-1.6023	0.5863
F14	-0.0005	-0.0092	0.5883**	0.1347	1.2177**	0.6029	0.0378	-2.8925*	-0.9458	1.0641	0.3790	-3.2684	0.1366
F15	-0.0048	0.0005	1.0743***	-0.0997	0.6473**	-0.1096	0.9900***	-2.6848***	-1.5366***	0.6479	0.3648	-1.4644	0.6166
F16	-0.0006	-0.0033	0.6322***	0.0236	0.9362	0.4475	0.0862	-3.1207**	-0.4100	0.2900	0.6472	-4.1278**	0.1212
F17	-0.0019	0.0165	0.6791**	-0.4622	1.6768**	-1.6085	-0.1997	-2.7376*	0.5550	-1.2826	0.9273	-5.3280*	0.0578
F19	-0.0050	0.0059	1.4631***	-0.6287**	0.6657**	-0.1925	1.0291***	-2.0344**	-0.9294	-1.7172*	0.2021	-1.9430	0.6255
F20	-0.0056	0.0070	1.2458***	-0.3803	0.2678	0.0019	0.7541***	-2.0874***	-1.4118***	-0.6035	-0.0518	-1.9550**	0.7071
F21	-0.0011	0.0219	0.8877***	-0.6334	2.2939***	-1.1764	-0.3354	-2.7363	0.6086	-2.8828	0.8681	-6.5588**	0.1936
F22	-0.0033	0.0062	1.3658***	-0.8343**	2.0439***	-0.8961	0.2793	-1.7602*	-0.4434	-3.4691***	-0.2591	-2.4100	0.5994
F23	-0.0077**	0.0082	1.1471***	-0.1970	0.5402***	-1.4944***	1.0029***	-1.7919***	-0.2422	-0.2570	0.8702***	-0.6938	0.6710
F24	0.0005	-0.0030	0.6218**	0.0510	0.9637	1.0661	0.2946	-3.8163***	-0.9823	0.7836	0.2449	-4.0212**	0.1536
F25	-0.0016	0.0002	0.6457***	-0.4613	1.3030**	-0.5408	-0.6698	-0.2455	1.8738*	-3.1064*	0.7208	-3.1510	0.1063
F27	-0.0083**	0.0090	1.3018***	-0.3176	0.6525***	-1.2458**	0.9793***	-2.5664***	-0.3632	-0.5135	0.6205*	-1.7735*	0.7012
F28	-0.0106***	0.0025	1.1981***	-0.1959	1.0354***	-1.1231	0.2680	0.6704	0.1620	-3.3106*	0.5618	-0.9654	0.6207

Appendix 25. Individual results of green mutual funds for the of Fama and French (2015) model including a dummy variable for expansion and recession periods (FTSE4GOOD Global Index)

The table reports individual estimation of European green mutual funds, considering the period December 2003 to November 2019. The results are obtained by the regression of the Fama and French (2015) five-factor model including a dummy variable to distinguish between expansion and recession periods (eq. 6), using FTSE4GOOD Global Index as the market proxy. D_t refers to the dummy variable that takes a value of 0 in expansion periods and a value of 1 in recession periods. Additionally, it presents the performance estimates in non-crisis periods ($\alpha_{0,p}$), the alpha coefficient for crisis periods ($\alpha_{rec,p} \times D_t$), the beta coefficients β_{MKT}, β_{SMB}, β_{HML}, β_{CMA}, and β_{RMW}, represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML)), investment (CMA) and profitability (RMW) factors for non-crisis periods and the coefficients $\beta_{MKT} \times D_t$, $\beta_{SMB} \times D_t$, $\beta_{HML} \times D_t$, $\beta_{CMA} \times D_t$ and $\beta_{RMW} \times D_t$ represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML)), investment (CMA) and profitability (RMW) factors for the crisis periods. The $Adj.\ R^2$ refers to the adjusted coefficient of determination.
The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. Funds F1, F6, F20, and F21 were excluded from this analysis, due to missing data for the recession periods.

Panel B: FTSE4GOOD Global Index

	$\alpha_{0,p}$	$\alpha_{rec,p} \times D_t$	β_{MKT}	$\beta_{MKT} \times D_t$	β_{SMB}	$\beta_{SMB} \times D_t$	β_{HML}	$\beta_{HML} \times D_t$	β_{CMA}	$\beta_{CMA} \times D_t$	β_{RMW}	$\beta_{RMW} \times D_t$	Adj. R^2
F2	-0.0053***	0.0012	1.0323***	0.1515	0.5587***	0.3338	-0.2734**	0.7371	-0.0335	-0.5157	0.0952	1.3918	0.8799
F3	-0.0071**	0.0033	1.1733***	-0.3759	0.7705***	-0.6795	0.4173*	-0.5910	0.3165	-0.2901	0.0777	-0.7311	0.7225
F4	-0.0045*	-0.0003	1.0458***	-0.1681	0.3583**	0.5557	0.1944	0.0738	-0.1269	-0.4735	0.1144	-0.6653	0.7787
F5	-0.0064***	0.0034	0.9097***	-0.0427	0.3441***	-0.2114	-0.1402	-0.5010	0.0528	0.0786	0.1741	-0.9633	0.8050
F7	-0.0022	-0.0021	1.0298***	-0.1697	0.1111	0.2713	-0.2180	-0.0861	0.4980**	-0.6766*	0.3766*	-1.0890**	0.8396
F8	-0.0069***	-0.0019	1.0590***	0.1773	0.4712***	0.5979	-0.1903	0.5131	-0.0713	0.3277	0.2097	0.8191	0.8421
F9	-0.0002	-0.0051	1.0288***	0.0600	0.9961***	0.4062	-0.0815	-0.5035*	-0.0121	0.2463	0.2882	0.4711	0.8439
F10	-0.0020	-0.0067	1.1938***	0.0939	0.6100***	0.6560	-0.1966	-0.0535	-0.3037	-0.2788	0.0574	0.5418	0.8851
F11	-0.0050**	-0.0035	1.0998***	0.0221	0.4804***	0.4024	-0.1752	-0.2671	-0.0330	-0.2677	0.1768	-0.0330	0.8533
F12	-0.0081***	0.0175*	1.2197***	-0.0978	1.1208***	-0.5677	0.1580	-0.6392	0.3393	-1.9642	-0.2343	-1.0654	0.8037
F13	-0.0048	-0.0000	1.2387***	-0.0430	0.8286***	0.5388	0.1625	-0.7098	-0.5206	-0.2643	0.2855	-0.8236	0.7355
F14	-0.0043**	-0.0030	1.0942***	0.0970	0.6730***	0.1714	-0.0199	-0.7754**	0.0522	-0.0178	0.2238	-0.1285	0.8636
F15	-0.0040	0.0038	1.2197***	-0.0366	0.6878***	0.4625	-0.0556	-0.7978**	0.6805**	-0.6070	0.2879	-1.2109**	0.8307
F16	0.0009	-0.0016	0.9510***	0.1579	0.5702***	0.3929	0.0546	-0.6607***	-0.0469	0.2304	0.1305	0.1704	0.8732
F17	0.0003	-0.0119*	1.0705***	0.0419	0.8150***	0.5011	-0.0520	-1.0384**	-0.7489***	1.0426***	-0.0716	0.1029	0.7647
F18	-0.0034	-0.0142	1.2403***	0.0870	0.8028***	0.6682	0.1398	-0.7881	-0.5904	0.9604	-0.6436	-0.7689	0.7177
F19	-0.0017	-0.0055	1.0149***	-0.1228	0.3876**	-0.5618	0.4421**	-1.0525***	-0.8223***	0.4659	0.9202***	-0.6143	0.7346

Appendix 26. Individual results of black mutual funds for the Fama and French (2015) model including a dummy variable for expansion and recession periods (FTSE All-World Mining Index)

The table reports individual estimates of European black mutual funds, considering the period December 2003 to November 2019. The results are obtained by the regression of the Fama and French (2015) five-factor model including a dummy variable to distinguish between expansion and recession periods (eq. 6), using FTSE All-World Mining Index as the market proxy. D_t refers to the dummy variable that takes a value of 0 in expansion periods and a value of 1 in recession periods. Additionally, it presents the performance estimates in non-crisis periods ($\alpha_{0,p}$), the alpha coefficient for crisis periods ($\alpha_{rec,p} \times D_t$), the beta coefficients β_{MKT}, β_{SMB}, β_{HML}, $\beta_{CMA,}$ and β_{RMW}, represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML)), investment (CMA) and profitability (RMW) factors for non-crisis periods and the coefficients $\beta_{MKT} \times D_t$, $\beta_{SMB} \times D_t$, $\beta_{HML} \times D_t$, $\beta_{CMA} \times D_t$ and $\beta_{RMW} \times D_t$ represent the factor loadings on the market (MKT), size (SMB), book-to-market (HML)), investment (CMA) and profitability (RMW) factors for the crisis periods. The $Adj.\ R^2$ refers to the adjusted coefficient of determination.

The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. Funds F2, F10, F18, and F26 were excluded from this analysis, due to the missing data for recession periods.

Panel C: FTSE All-World Mining Index													
	$\alpha_{0,p}$	$\alpha_{rec,p} \times D_t$	β_{MKT}	$\beta_{MKT} \times D_t$	β_{SMB}	$\beta_{SMB} \times D_t$	β_{HML}	$\beta_{HML} \times D_t$	β_{CMA}	$\beta_{CMA} \times D_t$	β_{RMW}	$\beta_{RMW} \times D_t$	Adj. R^2
F1	-0.0037	0.0020	0.7479***	0.1544	0.3602*	-0.2001	0.2609	-1.0392**	-0.1713	1.2190**	0.3141	-0.3780	0.8282
F3	-0.0067	-0.0109	0.9590***	0.3830*	0.7743**	1.1798	-0.8217**	-1.3408	0.3394	3.3039***	0.7657	-0.5215	0.6033
F4	-0.0013	0.0032	0.8220***	-0.0063	0.0354	-0.6621***	0.3200***	-0.4810**	-0.2235	0.0354	0.0563	-0.3330	0.9634
F5	-0.0061	-0.0099	0.9716***	0.4506	0.8754**	1.2023	-0.7444*	-1.4531*	0.5357	3.3537**	0.5495	0.1524	0.6268
F6	-0.0018	-0.0104	0.5010***	-0.3022	-0.2096	0.1172	0.8680***	-3.0324*	-1.0616***	2.9714	-0.0516	-4.3112	0.7300
F7	-0.0076	-0.0068	0.9688***	0.0591	1.2109**	-0.1504	-0.7571	-0.8440	0.7315	0.3770	1.5212**	-2.1108	0.5462
F8	-0.0062	0.0265**	0.5566***	-0.1154	0.3014	-1.3240	1.2269***	-1.2425*	-1.5874***	-0.5431	-0.9630*	-1.1645	0.6409
F9	-0.0023	0.0028	0.6842***	0.1253	0.2667	0.3357	0.5013**	-1.3718***	-1.0335***	1.1735*	0.1094	-0.6598	0.7953
F11	-0.0036*	0.0006	0.7574***	0.0250	0.3065**	0.0356	0.1723	-1.0205***	-0.5152**	0.4459	-0.0190	-0.4909	0.8996
F12	-0.0066	-0.0090	0.9936***	0.2710	1.1751***	0.9968	-0.7965*	-1.3707	0.3818	2.6963**	0.5048	-0.8645	0.6294
F13	-0.0008	-0.0003	0.5818***	0.3004**	0.1583	-0.0379	0.5775***	-1.3522***	-1.3862***	2.3693***	-0.2532	0.0363	0.7804
F14	-0.0071	-0.0106	0.9441***	0.3588	0.8455**	1.4471	-0.9016**	-1.0177	0.5422	3.2121*	0.7236	-0.5334	0.5866
F15	-0.0016	-0.0001	0.5938***	0.3583***	0.2999	0.2061	0.7180***	-1.3250***	-1.4991***	2.1624***	-0.0941	0.1956	0.7883
F16	-0.0066	-0.0048	0.9327***	0.2647	0.5603	1.2646	-0.8188*	-1.3637	0.9952	2.2482*	0.9389	-1.5685	0.5464
F17	-0.0046	-0.0019	1.0253***	0.3048	1.3139***	0.1582	-0.5977	-1.8664*	0.4630	2.4780*	1.5091**	-0.4969	0.5808
F19	-0.0025	0.0049	0.9401***	-0.0910	0.1540	0.3204	0.4909**	-0.5574	-0.5668*	-0.6095	-0.2964	-0.2915	0.9145
F20	-0.0011	0.0048	0.6259***	0.2153*	-0.1166	0.3546	0.5188**	-0.8867*	-1.5170***	0.8620	-0.6444**	-0.3117	0.8116
F21	-0.0035	0.0141	1.2204***	-0.1663	1.8266***	0.1508	-0.7696	-1.7410	0.4124	0.8814	1.4811*	-3.0591	0.6317
F22	-0.0016	0.0050	0.9341***	-0.3652**	1.5378***	-0.3660	0.1909	-1.0679	-0.7797	-2.0798**	-0.4323	-1.3998	0.8124
F23	-0.0018	0.0105	0.4381***	0.1354	0.2269	-1.5067**	0.9628***	-0.7676	-0.6670*	0.2032	0.1914	-0.1457	0.5736
F24	-0.0062	-0.0034	0.9790***	0.2192	0.5758	1.8815*	-0.6742	-1.9801**	0.5458	2.5799**	0.5911	-1.5536	0.5882
F25	-0.0026	-0.0048	0.8536***	-0.2814	0.8343*	0.2476	-1.0114**	0.3863	1.8661***	-1.1724	0.9374	-1.7022	0.5079
F27	-0.0014	0.0134	0.4906***	-0.0623	0.2989	-1.3672	0.9422***	-1.5454**	-0.8608**	-0.6697	-0.1562	-1.7405*	0.5798
F28	-0.0043	0.0077	0.6669***	-0.2629	0.2683	-1.4939**	0.2665	-1.0809	-0.7695**	-0.3348	0.1674	-2.7888**	0.7557

Appendix 27. Individual performance results of green mutual funds using the unconditional four-factor model (FTSE Environmental Opportunities Index)

The table reports individual estimates of European black mutual funds, considering the period May 2008 to November 2019.The results are obtained by the regression of the unconditional four-factor model (eq. 1), using FTSE Environmental Opportunities All-Share Index.
The performance estimates (α_p), the systematic risk (β_{MKT}), the adjusted coefficient of determination ($Adj.\ R^2$) and the regression coefficients of size (SMB), book-to-market (HML) and momentum (MOM) factors are presented. The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994).

Panel A: Unconditional four-factor - FTSE Environmental Opportunities All-Share Index						
	α_p	β_{MKT}	β_{SMB}	β_{HML}	β_{MOM}	Adj. R^2
F1	0.0012	0.9044***	0.5066***	-0.0800	-0.2920***	0.9205
F2	-0.0031**	0.8609***	0.1624	-0.2359**	0.0190	0.8600
F3	-0.0053*	0.9015***	0.2558	0.3455*	-0.2187	0.7026
F4	-0.0074***	0.9594***	0.0145	0.1829	-0.0280	0.8155
F5	-0.0049***	0.7833***	-0.1170	-0.0296	0.0466	0.7748
F6	-0.0027	0.9491***	0.1640	-0.1543	-0.0946	0.9252
F7	-0.0035**	0.8924***	-0.2717**	-0.0399	0.0162	0.8576
F8	-0.0041**	0.8644***	0.1023	-0.1690*	-0.0034	0.7907
F9	-0.0012	0.8637***	0.5787***	-0.1769**	-0.0448	0.9103
F10	-0.0062***	1.1419***	0.2593**	-0.3268***	-0.1180**	0.9282
F11	-0.0066***	0.9975***	0.0729	-0.1935**	-0.0755	0.8947
F12	-0.0069***	1.1235***	0.6010***	0.3022*	-0.0887	0.7877
F13	-0.0110***	1.1655***	0.4361**	-0.2108	-0.0844	0.8496
F14	-0.0064***	1.0138***	0.2507**	-0.0316	0.0322	0.9237
F15	-0.0037*	1.1086***	0.2175	0.1782	0.0781	0.8530
F16	-0.0005	0.8694***	0.2182**	-0.0262	-0.0277	0.9031
F17	-0.0049**	0.9619***	0.4945***	-0.2219*	0.0851	0.8178
F18	-0.0058*	1.1676***	0.6600***	0.0135	-0.2082	0.7381
F19	-0.0040*	0.8685***	-0.0929	-0.2488*	0.0408	0.7478
F20	-0.0018	0.9107***	0.1391	0.0733	-0.1537	0.8193
F21	-0.0030*	0.8219***	-0.0895	-0.0741	-0.0493	0.9011

Appendix 28. Individual performance results of green mutual funds using the unconditional five-factor model (FTSE Environmental Opportunities Index)

The table reports individual estimates of European black mutual funds, considering the period May 2008 to November 2019.The results are obtained by the regression of the unconditional five-factor model (eq. 2), using FTSE Environmental Opportunities All-Share index.
The performance estimates (α_p), the systematic risk (β_{MKT}), the adjusted coefficient of determination ($Adj.\ R^2$) and the regression coefficients of size (SMB), book-to-market (HML) investment (CMA) and profitability (RMW) factors are presented. The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994).

Panel B: Unconditional five-factor – FTSE Environmental Opportunities All-Share Index							
	α_p	β_{MKT}	β_{SMB}	β_{HML}	β_{CMA}	β_{RMW}	Adj. R^2
F1	0.0007	0.9864***	0.5130**	0.0104	0.2732	0.0462	0.8973
F2	-0.0033**	0.8657***	0.1939	-0.1844	-0.0603	0.1331	0.8592
F3	-0.0067**	0.9607***	0.2462	0.4489*	0.1576	-0.0224	0.6904
F4	-0.0069***	0.9312***	-0.0179	0.3122*	-0.2688	-0.0247	0.8163
F5	-0.0042**	0.7564***	-0.1596	-0.0756	-0.0666	-0.1440	0.7730
F6	-0.0029	0.9932***	0.2020	-0.2417	0.3338	0.0360	0.9226
F7	-0.0043**	0.9120***	-0.2256*	-0.0501	0.1128	0.1733	0.8577
F8	-0.0043***	0.8716***	0.1292	-0.0998	-0.0704	0.1233	0.7892
F9	-0.0023	0.8899***	0.6492***	-0.0419	-0.0169	0.3297**	0.9121
F10	-0.0055***	1.0952***	0.2192*	0.0588	-0.6355***	0.0899	0.9357
F11	-0.0064***	0.9835***	0.0604	-0.0071	-0.2744*	0.0475	0.8950
F12	-0.0060**	1.0965***	0.4738**	0.1584	0.1148	-0.5180	0.7899
F13	-0.0093***	1.1009***	0.3360*	0.0410	-0.5853***	-0.2137	0.8553
F14	-0.0062***	0.9952***	0.2406**	-0.0030	-0.1008	0.0266	0.9232
F15	-0.0039*	1.1147***	0.2233	0.0161	0.2152	-0.0456	0.8518
F16	-0.0005	0.8673***	0.2210**	0.0457	-0.0890	0.0471	0.9025
F17	-0.0033	0.8970***	0.3958**	-0.2705*	-0.2309	-0.3038	0.8179
F18	-0.0039	1.0983***	0.3814	0.2048	-0.7103*	-0.7646**	0.7507
F19	-0.0047*	0.8372***	-0.0380	0.0490	-0.4032	0.5238*	0.7606
F20	-0.0025	0.9556***	0.1255	0.0711	0.2643	-0.0685	0.8135
F21	-0.0034**	0.8257***	-0.0647	0.0802	-0.1423	0.1660	0.9003

Appendix 29. Individual performance results of black mutual funds using the unconditional four-factor model (S&P Global Natural Resources Index)

The table reports individual estimates of European black mutual funds, considering the period December 2009 to November 2019.The results are obtained by the regression of the unconditional four-factor model (eq. 1), using S&P Global Natural Resources index. The performance estimates (α_p), the systematic risk (β_{MKT}), the adjusted coefficient of determination ($Adj.\ R^2$) and the regression coefficients of size (SMB), book-to-market (HML) and momentum (MOM) factors are presented. The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994).

Panel A: Unconditional four-factor – S&P Global Natural Resources						
	α_p	β_{MKT}	β_{SMB}	β_{HML}	β_{MOM}	Adj. R^2
F1	-0.0040	1.0444***	0.4098*	-0.1706	0.0449	0.7314
F2	-0.0015	0.8621***	0.0137	-0.0129	-0.1130	0.8930
F3	-0.0051	0.8380***	1.1394*	-1.0390**	-0.0272	0.2202
F4	-0.0020	1.1132***	0.2148	0.0139	0.0376	0.8511
F5	-0.0045	0.9091***	1.2445**	-0.8752*	0.0254	0.2588
F6	-0.0035***	0.9682***	-0.0571	0.1985**	0.0975	0.9420
F7	-0.0053	0.8383***	1.2182**	-0.9345*	-0.0023	0.2232
F8	-0.0084**	1.1707***	0.4248*	0.2217	-0.1626	0.7802
F9	-0.0031	0.9778***	0.2540	-0.2378	-0.0979	0.7927
F10	-0.0045**	0.8939***	-0.1609	-0.1795	-0.0873	0.8987
F11	-0.0056**	1.0286***	0.3957**	-0.2945*	0.0398	0.8027
F12	-0.0050	0.9622***	1.3709**	-1.0383**	-0.1073	0.2913
F13	-0.0040	0.9664***	1.3532**	-0.8574*	-0.0804	0.3259
F14	-0.0057	0.8272***	1.1769**	-1.0019**	-0.0418	0.2206
F15	-0.0033	0.8970***	0.3341**	-0.0901	-0.0887	0.8286
F16	-0.0027	0.8438***	0.9241	-0.9030*	-0.1963	0.2117
F17	-0.0041	0.9442***	1.3265**	-0.8711*	0.1766	0.2652
F18	-0.0137**	1.0778***	0.5675	0.1949	0.2827	0.4677
F19	-0.0050	1.3706***	0.5820**	-0.0804	-0.1066	0.7989
F20	-0.0044*	1.0829***	0.1586	-0.3417**	-0.1999*	0.8544
F21	-0.0013	1.1605***	1.8522***	-1.1256**	-0.0596	0.3207
F22	-0.0072	1.3596***	1.6062***	-0.3922	0.1686	0.6599
F23	-0.0013	0.9108***	0.0164	0.3431**	0.0484	0.7989
F24	-0.0034	0.9343***	1.0331*	-1.0367**	-0.2477	0.2540
F25	-0.0037	0.8184***	0.8412	-0.7277	-0.0094	0.2379
F26	-0.0014	0.8706***	-0.1193	0.1300	-0.0571	0.7438
F27	-0.0029	1.0903***	0.0560	0.1186	-0.0361	0.7570
F28	-0.0049*	0.9903***	0.3910**	-0.5000***	-0.1895	0.8025

Appendix 30. Individual performance results of black mutual funds using the unconditional five-factor model (S&P Global Natural Resources Index)

The table reports individual estimates of European black mutual funds, considering the period December 2009 to November 2019.The results are obtained by the regression of the unconditional five-factor model (eq. 2), using S&P Global Natural Resources Index. The performance estimates (α_p), the systematic risk (β_{MKT}), the adjusted coefficient of determination ($Adj.\ R^2$) and the regression coefficients of size (SMB), book-to-market (HML) investment (CMA) and profitability (RMW) factors are presented. The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994).

Panel B: Unconditional five-factor – S&P Global Natural Resources Index							
	α_p	β_{MKT}	β_{SMB}	β_{HML}	β_{CMA}	β_{RMW}	Adj. R^2
F1	-0.0062*	1.1136***	0.6307***	-0.1719	0.4830	0.8478**	0.7452
F2	-0.0011	0.8667***	-0.0513	0.0325	-0.0693	-0.2285	0.8903
F3	-0.0097	0.9682***	1.5304**	-0.8546	0.6065	1.5963	0.2366
F4	-0.0029	1.1473***	0.3020	-0.1588	0.5298*	0.2561	0.8554
F5	-0.0086	1.0334***	1.6150***	-0.8678	0.8596	1.4324	0.2746
F6	-0.0035***	0.9796***	0.0540	0.0525	0.3336**	0.2349	0.9449
F7	-0.0093	0.9604***	1.5704**	-0.9140	0.8258	1.3710	0.2370
F8	-0.0079**	1.1446***	0.3113	0.4780*	-0.5972	-0.3055	0.7816
F9	-0.0049**	1.0255***	0.3679**	-0.0805	0.0822	0.5219	0.7952
F10	-0.0051**	0.8988***	-0.1472	0.1199	-0.3688	0.2222	0.8997
F11	-0.0067**	1.0652***	0.5069**	-0.3751*	0.3896	0.3895	0.8067
F12	-0.0099	1.1035***	1.7479***	-0.8827	0.7459	1.5392	0.3068
F13	-0.0078	1.0854***	1.6349***	-0.9623*	1.0292	1.0527	0.3379
F14	-0.0104	0.9663***	1.5702**	-0.9092	0.8284	1.5667*	0.2392
F15	-0.0037*	0.8982***	0.3391**	0.1794	-0.4378*	0.1492	0.8304
F16	-0.0091	1.0304***	1.3821**	-0.7663	1.1104	1.8555*	0.2388
F17	-0.0073	1.0446***	1.6947***	-0.9267	0.7762	1.3768	0.2763
F18	-0.0130**	1.0734***	0.7020	-0.2393	0.6278	0.1204	0.4601
F19	-0.0064*	1.4085***	0.6648**	0.0864	-0.0024	0.4071	0.7979
F20	-0.0038*	1.0500***	0.0197	-0.0103	-0.7678***	-0.3659	0.8607
F21	-0.0057	1.2894***	2.2036***	-1.0527	0.7924	1.3980	0.3292
F22	-0.0059	1.3274***	1.5689***	-0.5730	0.0572	-0.2450	0.6558
F23	-0.0016	0.9260***	0.0574	0.1860	0.3680	0.0833	0.7997
F24	-0.0090	1.0917***	1.4068**	-0.7529	0.6616	1.6007*	0.2661
F25	-0.0078	0.9634***	1.1536**	-1.2936**	1.9878*	0.9594	0.2762
F26	-0.0023	0.8946***	-0.0209	0.2507	0.0427	0.3804	0.7438
F27	-0.0030	1.0928***	0.0489	0.1430	-0.0187	-0.0122	0.7547
F28	-0.0070***	1.0444***	0.4784**	-0.2443	-0.0399	0.5089*	0.8009

Appendix 31 : Individual performance results of green mutual funds using the conditional four-factor model (FTSE Environmental Opportunities All-Share Index)

The table reports individual estimates of European green mutual funds, considering the period May 2008 to November 2019.The results are obtained by the regression of the conditional four-factor model (eq.3), using FTSE Environmental Opportunities All-Share Index. Additionally, it presents the performance estimates (α_p), the conditional alphas coefficients (α_{DY}, α_{TB}), the systematic risk (β_{MKT}), the conditional beta estimates (β_{MKT*DY}, β_{MKT*TB}, β_{SMB*DY}, β_{SMB*TB}, β_{HML*DY}, β_{CMA*DY}, β_{CMA*TB}, β_{RMW*DY} and β_{RMW*TB}), the regression coefficients of size (SMB), book-to-market (HML), investments (CMA) and profitability (RMW) factors and the adjusted coefficient of determination ($Adj.\ R2$). The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. w1, w2 and w3 correspond to the probability values from the Wald test on the existence of time-varying alphas, time-varying betas and joint time-varying alphas and betas.

Panel A: Conditional four-factor model – FTSE Environmental Opportunities All-Share Index

	α_p	α_{DY}	α_{TB}	β_{MKT}	β_{MKT*DY}	β_{MKT*TB}	β_{SMB}	β_{SMB*DY}	β_{SMB*TB}	β_{HML}	β_{HML*DY}	β_{HML*TB}	β_{MOM}	β_{MOM*DY}	β_{MOM*TB}	Adj. R^2	w1	w2	w3
F1	0.0082	0.0443*	-0.6005	0.8507***	0.7149	38.7124	1.0759***	1.5337	-97.7325	0.1886	2.5672	-41.6520	0.0192	2.5120	-89.1949	0.9108	0.2251	0.1864	0.0331
F2	-0.0026	0.0038	0.0166	0.8509***	0.0675	23.0732	0.1276	0.5032	19.3909	-0.2255**	1.2126	29.8816	0.0127	0.0020	13.5810	0.8507	0.9637	0.3930	0.4191
F3	-0.0068**	0.0060	2.7982**	0.9143***	1.2149	-0.6152	0.2612	3.7430	74.8345	0.5114**	2.3548	41.5773	-0.1050	0.5875	32.7104	0.7080	0.0974	0.5321	0.3287
F4	-0.0069***	0.0073	0.7382	0.9679***	-0.0300	2.3054	0.0200	0.1325	-110.0602**	0.1969	0.6370	-2.7869	-0.1178	0.0960	-21.9396	0.8192	0.5024	0.1388	0.2512
F5	-0.0041**	0.0059	0.2696	0.8236***	-0.0402	3.4131	-0.0888	-0.0826	-11.7538	-0.0163	0.7835**	48.0467*	0.0071	0.4200*	19.0431	0.7693	0.6697	0.4613	0.4441
F6	-0.0056	-0.0283	0.8051	0.7893***	2.0182**	19.9962	-0.6742*	1.8219	173.1561*	-0.1933	-4.9132**	83.7747*	-0.3084	1.5163	134.6070**	0.9582	0.4061	0.0166	0.0280
F7	-0.0033*	0.0093	0.2673	0.9286***	-0.3303**	-14.1365	-0.2279*	-0.3883	-23.3239	-0.1418	0.6503*	-3.4234	-0.0768	0.1772	-6.7696	0.8579	0.4247	0.2650	0.4221
F8	-0.0037*	0.0207	0.0837	0.8823***	-0.0874	15.5948	0.0331	0.8342	61.8164	-0.1072	2.5872	16.4849	0.0122	-0.2779	20.0430	0.7907	0.5427	0.0598	0.0660
F9	-0.0013	0.0034	0.4231	0.8968***	-0.2095*	-2.7570	0.5814***	-0.1721	-30.4911	-0.1693*	0.5854**	39.8875*	-0.0537	0.0874	10.4986	0.9098	0.5743	0.3358	0.5091
F10	-0.0052***	0.0016	1.2066**	1.1248***	-0.1401	-12.3043	0.2736**	-0.0269	-21.0568	-0.2784***	0.6196	68.5452**	-0.1151*	-0.0313	3.0112	0.9341	0.0448	0.0362	0.0339
F11	-0.0068***	0.0059	0.9557**	1.0073***	-0.1922*	-4.2864	0.0841	-0.0025	-36.2718	-0.1150	0.3875	50.8974**	-0.0116	-0.0777	14.4812	0.8957	0.0632	0.0002	0.0003
F12	-0.0089***	0.0136	2.2910*	1.0902***	0.5535*	-57.8043	0.4939***	0.4444	235.0159***	0.5121***	0.8373	-14.1945	0.0058	-1.5042*	59.8505	0.8081	0.2276	0.0089	0.0065
F13	-0.0098***	0.0104	1.7285**	1.1394***	-0.0308	-9.2429	0.4380**	0.5247	-67.5071	-0.0582	0.1160	84.4708**	-0.0850	-0.0778	-11.0436	0.8637	0.0508	0.0108	0.0127
F14	-0.0057***	-0.0047	1.0438**	0.9978***	-0.0723	-8.0136	0.2478**	-0.0516	-24.8198	-0.0704	0.0310	30.6896	-0.0975*	-0.2092	-35.0598***	0.9322	0.0483	0.0353	0.0623
F15	-0.0040*	0.0050	1.1169*	1.1548***	-0.1486	11.1218	0.2242	0.2549	-120.4605**	0.2413*	0.7890*	39.7919	0.0033	-0.0744	-17.2053	0.8627	0.2342	0.0192	0.0444
F16	-0.0007	-0.0026	0.7711*	0.8837***	-0.1736	-2.2716	0.2077*	-0.2497	-34.9629	-0.0018	0.5749*	51.5641**	-0.0380	-0.1883	-3.7915	0.9074	0.0923	0.0785	0.1053
F17	-0.0042*	-0.0047	1.4795**	0.9889***	-0.1207	6.3130	0.5406***	0.2493	-41.9743	-0.2594*	0.3820	42.8115	-0.0797	-0.0524	-24.2431	0.8254	0.0280	0.1190	0.1184
F18	-0.0084**	-0.0705***	0.9682	1.1307***	0.0512	-17.2331	0.5095**	-1.5756	87.9277	-0.0459	-2.2378	24.9232	-0.2372	-1.5603	-43.5772	0.7403	0.0290	0.5513	0.3777
F19	-0.0038	0.0008	0.9667	0.9372***	-0.0584	18.3634	-0.0477	-0.3324	-73.4428	-0.3560**	0.4945	-2.6611	-0.1804*	0.2664	-20.1005	0.7626	0.3511	0.0339	0.0616
F20	-0.0028	0.0095	0.4285	0.8987***	-0.1860	-9.2969	0.1720	-0.2342	-28.1430	0.0833	-0.0062	-1.6072	-0.1330	-1.3658	-43.7489	0.8114	0.7763	0.7221	0.7496
F21	-0.0029	-0.0247	0.4711	0.6519***	1.2143***	58.6620**	-0.1441	-0.2039	13.5073	-0.2091*	-0.7225	74.2633*	-0.1974*	1.0517	73.7513*	0.9138	0.2607	0.0554	0.1059

Appendix 32. Individual performance results of green mutual funds using the conditional five-factor model (FTSE Environmental Opportunities All-Share Index)

The table reports individual estimates of European green mutual funds, considering the period May 2008 to November 2019.The results are obtained by the regression of the conditional five-factor model (eq.4), using FTSE Environmental Opportunities All-Share Index. Additionally, it presents the performance estimates (α_p), the conditional alphas coefficients (α_{DY}, α_{TB}), the systematic risk (β_{MKT}), the conditional beta estimates (β_{MKT*DY}, β_{MKT*TB}, β_{SMB*DY}, β_{SMB*TB}, β_{HML*DY}, β_{CMA*DY}, β_{CMA*TB}, β_{RMW*DY} and β_{RMW*TB}), the regression coefficients of size (SMB), book-to-market (HML), investments (CMA) and profitability (RMW) factors and the adjusted coefficient of determination ($Adj.\ R^2$). The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. w1, w2 and w3 correspond to the probability values from the Wald test on the existence of time-varying alphas, time-varying betas and joint time-varying alphas and betas.

Panel A: Conditional five-factor model – FTSE Environmental Opportunities All-Share Index

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11
α_p	-0.0047	-0.0024	-0.0072*	-0.0076***	-0.0039**	-0.0014	-0.0044**	-0.0026	-0.0022	-0.0047***	-0.0057***
α_{DY}	0.0010	0.0105	0.0056	0.0124	0.0127*	-0.0529***	0.0098	0.0330*	0.0058	0.0058	0.0169**
α_{TB}	1.2561	0.1203	2.7986**	0.9353	0.1855	-1.0857	0.2951	0.0294	0.3809	0.7141	0.5882
β_{MKT}	1.0774***	0.8439***	0.9228***	0.9463***	0.7729***	1.0417***	0.9360***	0.8559***	0.9182***	1.1046***	0.9822***
β_{MKT*DY}	-0.0977	-0.2126	1.2616*	-0.1281	-0.1820	0.9645***	-0.3437*	-0.4650*	-0.1625	-0.0391	-0.0985
β_{MKT*TB}	-31.9778	24.6508	13.5484	7.8379	8.3905	-43.3060	-8.0827	21.7727	-0.9963	-2.9599	2.7130
β_{SMB}	0.7294	0.1532	0.1843	-0.0414	-0.1286	-0.4319	-0.2143	0.0230	0.6673***	0.2602**	0.1120
β_{SMB*DY}	-1.9607	-0.2782	3.4692	-0.1896	-0.4089	-0.8690	-0.5098	-0.1232	-0.1291	-0.1225	-0.1151
β_{SMB*TB}	-53.7152	43.5585	145.8270	-136.4235**	-13.4639	72.2406	-29.9312	105.7806*	-21.6507	-14.9006	-23.6613
β_{HML}	-0.2965	-0.1174	0.6426**	0.3442*	-0.0633	-0.6163	-0.1040	0.0124	-0.0505	0.0405	-0.0326
β_{HML*DY}	-0.3837	1.4793	2.2051	0.4712	-0.0307	-11.0584***	0.3774	3.3075	0.4389	0.6338	-0.1142
β_{HML*TB}	123.7213	-12.3625	-241.1287	-16.6831	-17.2420	121.7120	-14.3912	-28.8767	9.2713	15.2362	-32.3760
β_{CMA}	0.7054	-0.1662	-0.1705	-0.2435	-0.0755	0.9745	0.0962	-0.2315	0.0431	-0.4990***	-0.1537
β_{CMA*DY}	-6.9486	-1.5651	0.7768	-0.0277	0.8267	1.8873	0.2496	-2.7018	0.2328	0.6167	1.1009*
β_{CMA*TB}	-211.8846	69.1647	491.1708*	5.3106	87.3667	-250.3862	31.4847	91.4979	37.2771	63.6967	109.2440*
β_{RMW}	0.3951	0.1640	-0.1023	-0.0896	-0.2207	-1.3412***	0.0888	0.0236	0.3150*	0.0890	-0.0151
β_{RMW*DY}	-5.4938	-2.0492	-1.3047	-0.8726	-1.2041**	-10.1964***	-0.2471	-2.4266	0.1192	0.2890	-0.7178
β_{RMW*TB}	-111.5726	-36.1178	-21.4035	-64.6926	9.4061	230.7573***	4.7217	34.8982	-12.7542	-34.0965	-29.3596
Adj. R^2	0.8795	0.8507	0.7117	0.8147	0.7659	0.9490	0.8523	0.7904	0.9096	0.9387	0.8954
w1	0.8159	0.7178	0.1038	0.3911	0.2032	0.0069	0.5143	0.2177	0.6098	0.3830	0.1112
w2	0.8834	0.1174	0.2866	0.4010	0.2521	0.0000	0.7315	0.0267	0.6120	0.0927	0.3726
w3	0.7788	0.0892	0.1329	0.5424	0.3358	0.0000	0.8434	0.0331	0.7526	0.1131	0.4131

Appendix 32. (continued)

	F12	F13	F14	F15	F16	F17	F18	F19	F20	F21
α_p	-0.0048	-0.0090***	-0.0064***	-0.0047**	-0.0004	-0.0036	-0.0047	-0.0058**	-0.0018	-0.0055**
α_{DY}	0.0304	0.0157	-0.0077	-0.0010	-0.0026	-0.0063	-0.0563*	0.0009	0.0209	-0.0341
α_{TB}	1.5383	1.4061*	0.9372*	0.9651	0.3204	1.1534	0.5022	0.9286	0.4700	0.7334
β_{MKT}	1.0277***	1.1012***	1.0156***	1.1901***	0.9037***	0.9511***	1.0978***	0.9023***	0.9518***	0.7762***
β_{MKT*DY}	0.2923	0.0984	0.0664	-0.2130	-0.1237	0.0144	0.6860	0.2507	0.5583	0.7615*
β_{MKT*TB}	-19.5688	3.8704	4.5385	14.9467	2.2896	21.9328	16.5619	47.9571***	0.8139	17.0990
β_{SMB}	0.3911**	0.3742*	0.2172*	0.2161	0.2169*	0.4279**	0.2652	-0.0180	0.1829	0.0382
β_{SMB*DY}	-0.3987	0.2957	-0.1086	0.3319	-0.1466	0.0229	-0.1177	-0.7476	-0.3302	-0.3211
β_{SMB*TB}	302.5473***	-76.3259	-40.6613	-119.9529**	-22.6623	-57.1697	167.8910	-93.2132*	-15.7504	-24.7546
β_{HML}	0.3986	0.1133	-0.0217	0.0605	0.0042	-0.1471	0.4196	0.2909	0.0384	-0.0272
β_{HML*DY}	-0.5011	-0.2222	0.2200	1.3147**	0.9789***	0.1800	1.0267	-0.3828	-0.6794	-1.7500
β_{HML*TB}	-153.1573	23.5201	22.6777	54.5845	30.3189	24.6115	-306.4803*	-54.1708	-8.8136	94.9018
β_{CMA}	-0.0387	-0.3820	0.0636	0.4399*	0.1055	-0.3399	-1.2289***	-0.8781***	0.3122	0.1119
β_{CMA*DY}	2.0131	1.1388	0.2373	-0.8465	-0.2452	1.0216	-0.3380	2.4575***	0.8035	-0.5230
β_{CMA*TB}	240.7808	86.7498	33.8162	0.3310	34.8804	56.2985	716.1977**	117.5563	93.0213	-139.0775
β_{RMW}	-0.5282	-0.1504	0.0438	0.0320	0.0542	-0.2601	-0.6390	0.5344*	-0.2097	0.5789**
β_{RMW*DY}	-4.2276*	-0.3349	0.4202	0.5980	0.5878	0.0561	3.6517	0.0823	-3.4550	-0.3684
β_{RMW*TB}	119.0119	-59.5277	-57.6838	11.3761	-1.9516	-16.1248	73.7656	-56.3660	78.2451	-125.6981
Adj. R^2	0.8019	0.8651	0.9282	0.8635	0.9073	0.8239	0.7501	0.7942	0.8001	0.9080
w1	0.2975	0.1757	0.0238	0.3888	0.6420	0.1527	0.1483	0.4573	0.5510	0.2043
w2	0.0338	0.0608	0.0711	0.0148	0.0699	0.2208	0.4337	0.0009	0.9164	0.1548
w3	0.0205	0.0537	0.0591	0.0349	0.1090	0.1862	0.4735	0.0020	0.8632	0.2365

Appendix 33. Individual performance results of black mutual funds using the conditional four-factor model (S&P Global Natural Resources Index)

The table reports individual estimates of European black mutual funds, considering the period December 2009 to November 2019.The results are obtained by the regression of the conditional four-factor model (eq.3), using S&P Global Natural Resources Index. Additionally, it presents the performance estimates (α_p), the conditional alphas coefficients (α_{DY}, α_{TB}), the systematic risk (β_{MKT}), the conditional beta estimates (β_{MKT*DY}, β_{MKT*TB}, β_{SMB*DY}, β_{SMB*TB}, β_{HML*DY}, β_{CMA*DY}, β_{CMA*TB}, β_{RMW*DY} and β_{RMW*TB}), the regression coefficients of size (SMB), book-to-market (HML), investments (CMA) and profitability (RMW) factors and the adjusted coefficient of determination ($Adj.\ R2$). The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. w1, w2 and w3 correspond to the probability values from the Wald test on the existence of time-varying alphas, time-varying betas and joint time-varying alphas and betas.

Panel A: Conditional four-factor model – S&P Global Natural Resources Index

	α_p	α_{DY}	α_{TB}	β_{MKT}	β_{MKT*DY}	β_{MKT*TB}	β_{SMB}	β_{SMB*DY}	β_{SMB*TB}	β_{HML}	β_{HML*DY}	β_{HML*TB}	β_{MOM}	β_{MOM*DY}	β_{MOM*TB}	Adj. R^2	w1	w2	w3
F1	-0.0050	0.0053	1.2067	1.0574***	-0.1818	9.3277	0.4642*	-0.6533	-41.1157	-0.2853	0.6636	125.0600	0.0728	-0.6104	-65.9308	0.7233	0.7406	0.6176	0.7586
F2	-0.0012	0.0078	-0.6241	0.7913***	0.3719	56.9764***	0.2163	-4.9664**	-52.8774	-0.0224	0.3345	-8.0540	-0.1058	1.8584	-24.1960	0.8967	0.6834	0.0550	0.0063
F3	-0.0065	0.0488	4.4551	0.9300***	-0.7370	-76.7499	1.5022**	-2.3504	-119.5829	-1.3559**	3.0398	408.1387*	0.0903	-1.6864	-160.3077	0.2284	0.3085	0.3280	0.3528
F4	-0.0037	0.0043	2.3761*	1.1132***	-0.1881	4.5974	0.2924	-0.3704	-79.3091	-0.0634	0.0160	115.0179	0.0062	-0.4689	66.3366	0.8488	0.1647	0.7468	0.6060
F5	-0.0052	0.0546	4.1585	0.9775***	-0.5280	-61.5810	1.5861**	-2.0003	-38.1872	-1.1222*	3.1248	413.8967*	0.1734	-1.4683	-158.7797	0.2654	0.2735	0.3626	0.3666
F6	-0.0023	0.0307**	-0.2525	0.9371***	-0.5649*	18.5485	-0.0663	-1.4948	20.5633	0.2220**	0.9681	20.5502	0.0537	-0.7787	10.9401	0.9418	0.1040	0.6308	0.4697
F7	-0.0060	0.0499	4.3985	0.9437***	-0.7837	-79.6657	1.5838**	-2.3769	-101.9038	-1.2588**	3.3383	424.1467*	0.1063	-1.3385	-135.9044	0.2311	0.3015	0.3383	0.3554
F8	-0.0105***	-0.0108	-0.4057	1.1478***	0.1778	69.7293*	0.2949	-1.2807	-106.9643	0.3057	-0.5313	-122.0430	-0.1517	0.4947	-6.3696	0.7779	0.8361	0.4845	0.5528
F9	-0.0038	0.0067	0.0322	0.9922***	-0.1270	3.9821	0.2470	-1.2591	-29.0061	-0.2890	0.3249	36.5906	-0.0801	-0.2532	-32.5092	0.7788	0.8589	0.6276	0.7454
F10	-0.0056*	-0.0237	1.0188	0.7910***	0.1019	47.5583	-0.5694*	0.0159	158.7980	-0.2300	-1.7510	-4.2005	-0.2568	0.6478	20.0270	0.9032	0.3690	0.2633	0.3163
F11	-0.0063**	0.0061	1.1606	1.0391***	-0.1144	-3.9559	0.4462**	-0.8002	-16.1090	-0.4308**	-0.1871	146.4281*	0.0547	-0.2438	-36.9676	0.7997	0.6263	0.4417	0.6067
F12	-0.0070	0.0549	2.9094	1.0392***	-0.5160	-23.0945	1.5937**	-3.7543	-92.3439	-1.2038**	4.6589	323.1325	0.0987	-1.8855	-232.6369	0.3010	0.3624	0.2742	0.3266
F13	-0.0044	0.0608	2.8183	1.0054***	-0.4961	-27.8714	1.6519***	-2.3960	-49.4058	-1.0800**	1.9132	368.9834*	0.0371	-1.3073	-94.4440	0.3227	0.2659	0.5253	0.4954
F14	-0.0071	0.0508	4.4111	0.9377***	-0.7566	-76.3297	1.5247**	-2.7333	-127.2606	-1.2654**	4.3715	386.6995*	0.1003	-1.6396	-165.3241	0.2320	0.2902	0.3034	0.3183
F15	-0.0033	-0.0068	-0.2464	0.9157***	-0.1995	4.1413	0.3457*	-0.4438	-55.1155	-0.2410	-1.2596	21.7933	-0.1199	0.3722	-46.9074*	0.8208	0.6854	0.0869	0.1376
F16	-0.0024	0.0696	4.0248	0.9254***	-0.6691	-73.9945	1.4208**	-1.4890	-167.5282	-1.1442*	3.2677	400.5192*	-0.0447	-1.3250	-127.3562	0.2189	0.2135	0.4454	0.3651
F17	-0.0051	0.0458	3.4137	1.0173***	-0.5235	-58.8951	1.6271**	-2.4008	-91.2680	-1.1836**	2.4694	442.5756*	0.2934	-1.4140	-122.7316	0.2643	0.4214	0.3844	0.4605
F18	-0.0142**	-0.0868	-3.1245	0.8793***	-0.9433	293.3702***	0.5113	-4.2075	-210.3577	0.1099	-7.5267	-270.3873*	0.2211	3.4286	-213.0906	0.6118	0.1048	0.0002	0.0004
F19	-0.0064	-0.0027	1.7782	1.3425***	0.2708	-28.6627	0.6868**	1.2786	-105.3013	-0.0277	0.1992	72.6188	-0.0867	-0.9380	56.5903	0.7892	0.6653	0.8598	0.9055
F20	-0.0053**	-0.0214	-0.2844	1.0617***	0.3364*	-43.9306*	0.1356	0.6891	-35.7807	-0.4162**	-2.3509**	27.5839	-0.2179**	-0.1520	-10.9456	0.8641	0.2735	0.0989	0.0663
F21	-0.0006	0.0643	3.0626	1.2139***	-0.4976	2.3613	2.1714***	-1.3278	32.8670	-1.2774*	5.2747	421.3720	0.1389	-1.6139	-184.3147	0.3253	0.3663	0.3871	0.3861
F22	-0.0092	0.0187	3.4039	1.3246***	0.2675	30.8210	1.8057***	0.5363	-119.7590	-0.3630	1.0421	152.0540	0.3100	-0.6068	-117.4493	0.6533	0.3546	0.6582	0.6480
F23	-0.0014	0.0078	-1.4463	0.9159***	0.0328	14.4510	-0.0571	-1.7895*	6.8463	0.3438*	-0.8513	-77.8930	0.0862	0.6086	-79.9653	0.8015	0.4910	0.2508	0.3320
F24	-0.0044	0.0571	4.4034	1.0166***	-0.4700	-96.1587	1.3999**	-2.4715	-96.9175	-1.2767**	2.9113	443.4655*	-0.1192	-1.2122	-60.6489	0.2490	0.2790	0.4994	0.5140
F25	-0.0036	0.0452	6.0680	0.8402***	-0.0909	-46.5477	1.1661**	0.2807	154.4270	-0.8690*	3.0546	481.2241**	0.1405	-0.7340	-94.0667	0.2586	0.1364	0.2632	0.2290
F26	-0.0038	-0.0333**	-0.4996	0.8560***	0.5058	34.7460	-0.1965	-3.9241**	-35.5155	0.1327	-4.3735**	-94.6008	0.0083	0.8062	-50.1460	0.7453	0.1268	0.0075	0.0120
F27	-0.0055*	-0.0072	-0.7018	1.0810***	0.2498	-11.0884	-0.0752	-2.3243***	-79.7826	0.1436	-1.5572	-93.6203	-0.0100	-0.0404	-41.0712	0.7653	0.7570	0.0000	0.0000
F28	-0.0044	0.0201	0.3379	1.0416***	-0.3790	-28.0314	0.4578**	0.3587	0.1375	-0.5837***	0.3562	27.9664	-0.1356	-0.2790	-79.4155	0.7938	0.5726	0.8144	0.8695

Appendix 34. Individual performance results of black mutual funds using the conditional five-factor model (S&P Global Natural Resources Index)

The table reports individual estimates of European black mutual funds, considering the period December 2009 to November 2019.The results are obtained by the regression of the conditional five-factor model (eq. 4), using S&P Global Natural Resources Index. Additionally, it presents the performance estimates (α_p), the conditional alphas coefficients (α_{DY}, α_{TB}), the systematic risk (β_{MKT}), the conditional beta estimates (β_{MKT*DY}, β_{MKT*TB}, β_{SMB*DY}, β_{SMB*TB}, β_{HML*DY}, β_{CMA*DY}, β_{CMA*TB}, β_{RMW*DY} and β_{RMW*TB}), the regression coefficients of size (SMB), book-to-market (HML), investments (CMA) and profitability (RMW) factors and the adjusted coefficient of determination ($Adj.\ R^2$). The asterisks are used to identify the existence of statistical significance of the coefficients to a level of significance of 1% (***), 5% (**) and 10% (*). Regression residuals are tested using the White (1980) test for heteroscedasticity and a Breusch-Godfrey (1978) test for autocorrelation. Standard errors are corrected, whenever appropriate, for the presence of heteroscedasticity using the correction of White (1980) or for the presence of autocorrelation and heteroscedasticity using the procedure suggested by Newey and West (1994). N+ and N- indicate the number of the funds presenting positive (N+) and negative (N-) estimates. Within brackets are reported those funds, whose estimates are statistically significant at a 5% significance level. w1, w2 and w3 correspond to the probability values from the Wald test on the existence of time-varying alphas, time-varying betas and joint time-varying alphas and betas.

Panel B: Conditional five-factor model – S&P Global Natural Resources Index

	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14
α_p	-0.0083**	-0.0010	-0.0123	-0.0052**	-0.0116	-0.0030*	-0.0118	-0.0085**	-0.0065***	-0.0073**	-0.0080***	-0.0129	-0.0102	-0.0129
α_{DY}	-0.0110	0.0117	0.0229	-0.0048	0.0241	0.0162	0.0237	0.0004	-0.0007	-0.0279	0.0005	0.0307	0.0394	0.0260
α_{TB}	2.4826	-0.5064	7.0373*	2.6856**	6.8125*	0.0504	6.9026*	-0.7963	0.8993	1.5487	1.8179	5.2937	4.3519	6.9485*
β_{MKT}	1.1230***	0.8202***	1.0344***	1.1522***	1.0871***	0.9572***	1.0422***	1.1090***	1.0376***	0.8657***	1.0577***	1.1247***	1.0814***	1.0396***
β_{MKT*DY}	0.3768	-0.2968	0.5273	0.1501	0.7484	-0.4761**	0.4132	-0.1073	0.3574*	-0.2881	0.2190	0.8821	0.8158	0.4765
β_{MKT*TB}	27.4874	31.1215	-23.2620	16.3854	-24.0352	25.6413	-34.6999	64.7358	3.6251	23.7173	17.7944	45.3682	29.3190	-20.5403
β_{SMB}	0.7661***	0.1476	2.0950***	0.4208**	2.1918***	0.0397	2.1159***	0.0892	0.4287*	-0.4993	0.5896***	2.1985***	2.1460***	2.1117***
β_{SMB*DY}	0.0389	-3.5589*	-1.1726	-0.3062	-0.7421	-1.7652	-1.3395	-1.5839	-0.8210	1.1591	-0.6787	-2.6124	-1.7998	-1.5953
β_{SMB*TB}	31.6496	-7.8275	67.9974	-42.8632	80.6553	35.4211	64.0685	-78.2517	-25.8135	202.1664*	47.6360	57.6124	35.4156	54.9176
β_{HML}	-0.0314	0.1582	-0.3956	-0.1424	-0.4909	0.2028	-0.5110	0.6388*	0.0207	0.3981	-0.2951	-0.3397	-0.6864	-0.4142
β_{HML*DY}	0.3526	2.3065	2.9871	-0.5097	2.2530	1.5452	3.2597	1.3713	0.5862	0.7501	-0.4176	3.4292	0.1246	4.0177
β_{HML*TB}	-177.3064	-20.4645	-362.0193	-161.3237	-212.9005	20.2957	-355.8374	-183.3012	-180.7964	-95.9595	-106.6501	-256.8592	-121.6163	-351.4593
β_{CMA}	-0.1731	-0.1633	-1.2928	0.2297	-0.7764	0.1293	-0.9963	-0.7264	-0.3583	-0.6849	-0.1229	-1.1135	-0.3160	-1.0640
β_{CMA*DY}	3.6154	-5.7915**	7.6777	3.9702**	9.3211	-1.5985	7.7220	-5.2547*	2.7480*	-5.7926**	2.8868	10.4280*	12.5775**	7.9688
β_{CMA*TB}	715.8308**	51.8311	1,816.0477**	451.1839**	1,461.4331**	52.8285	1,729.2249**	98.2977	419.5342*	209.6395	559.1163**	1,587.5756**	1,194.6591*	1,754.6190**
β_{RMW}	1.0623***	0.1732	2.1885**	0.2866	2.0869**	0.3174	1.9507*	-0.4049	0.6478*	0.7274*	0.5026	1.9926**	1.3357	2.1238**
β_{RMW*DY}	3.2301	0.7066	6.6794	1.6158	6.7267	0.7495	6.2764	-0.9361	2.5601*	1.6056	1.1808	7.1256	6.3460	6.1700
β_{RMW*TB}	-21.8066	-51.5122	-22.9885	-28.9276	-160.7497	88.7974	-132.4330	-13.7165	-176.1887	-39.0549	6.7361	135.9636	129.7587	-9.0243
Adj. R^2	0.7619	0.8932	0.3063	0.8646	0.3311	0.9436	0.3005	0.7846	0.7930	0.9112	0.8177	0.3681	0.3890	0.3076
w1	0.3201	0.7725	0.1854	0.1054	0.1892	0.5620	0.1947	0.9076	0.4670	0.2512	0.3981	0.3041	0.3043	0.1785
w2	0.0486	0.0275	0.0283	0.1351	0.0468	0.5291	0.0381	0.2329	0.1105	0.1346	0.0601	0.0280	0.0495	0.0313
w3	0.0852	0.0051	0.0361	0.0914	0.0574	0.6097	0.0480	0.3427	0.1536	0.1796	0.1121	0.0401	0.0587	0.0380

Appendix 34. (continued)

	F15	F16	F17	F18	F19	F20	F21	F22	F23	F24	F25	F26	F27	F28
α_p	-0.0048**	-0.0100	-0.0104	-0.0208***	-0.0088**	-0.0040	-0.0086	-0.0097*	-0.0012	-0.0109	-0.0104	-0.0075*	-0.0035	-0.0067**
α_{DY}	-0.0096	0.0501	0.0218	-0.1421**	-0.0062	0.0002	0.0264	0.0055	0.0122	0.0369	0.0098	-0.0548	0.0118	0.0202
α_{TB}	0.3529	6.6876	5.7428	-1.6039	2.2695	-0.4637	5.7650	4.1166	-1.1979	6.8030	8.5253**	0.8686	-0.7893	0.9524
β_{MKT}	0.9328***	1.0552***	1.0903***	0.8755***	1.3844***	0.9999***	1.3309***	1.2752***	0.8886***	1.1476***	1.0066***	0.8699***	1.0226***	1.0696***
β_{MKT*DY}	0.0541	0.6605	0.6257	-1.8006*	0.9415**	0.5148**	1.2871	0.9703*	-0.1776	0.7350	0.5648	0.5376	-0.0049	-0.0009
β_{MKT*TB}	-12.0423	-19.0928	-15.7335	306.3221***	-14.8932	-21.5252	42.0155	73.0919	24.2702	-59.8031	-44.0659	24.7905	16.8559	-18.6600
β_{SMB}	0.3804*	2.0953***	2.1914***	0.7165	0.9357***	0.0127	2.8726***	1.8815***	-0.1334	1.9913***	1.6960***	0.0012	-0.2097	0.6222***
β_{SMB*DY}	-0.1457	-0.3303	-1.6184	-2.7268	1.3659	-0.0743	0.0270	0.2052	-1.9361*	-1.3345	2.0180	-3.6635	-2.9396***	0.7395
β_{SMB*TB}	-76.1590	11.9057	22.6913	-150.1527	-108.2413	-7.3131	82.5537	-71.0248	47.0964	84.5313	242.0565	-25.4246	-0.9907	-10.2743
β_{HML}	0.1351	-0.1985	-0.7050	0.2240	0.2753	0.1409	-0.5846	-0.3252	0.1884	-0.1151	-0.9466	0.3751	0.2516	-0.2225
β_{HML*DY}	-0.0058	3.1738	0.9741	-4.3560	-0.5448	-1.2851	3.5306	-0.4143	-0.6852	4.1374	2.2962	-3.7923	-1.1600	0.1371
β_{HML*TB}	-95.7567	-377.6071	-136.6897	-139.2239	-195.2036	-286.8207**	-125.2531	-204.6327	-118.7412	-381.0670	90.7916	-307.8696*	-304.6849**	-17.6161
β_{CMA}	-0.6338**	-0.8212	-0.6825	0.1018	-0.3732	-1.1574***	-0.9394	-0.7090	0.2882	-1.3640	0.8812	-0.4130	-0.2636	-0.2919
β_{CMA*DY}	-0.5923	8.4635	10.6769	-9.4545	7.1396**	1.1382	14.9932**	9.1551**	-2.0433	5.5018	2.9216	-3.6161	-1.9494	2.2396
β_{CMA*TB}	198.7585	1,793.0376**	1,325.4883*	178.1317	461.4293	535.8808**	1,358.9985	795.4492	123.7620	1,793.1415**	860.5047	415.5980	406.6743	196.0468
β_{RMW}	0.2995	2.4482**	1.8876*	0.9767	0.6372	-0.2958	2.1087*	0.0197	-0.1023	2.3235**	1.8817**	1.0029**	-0.2585	0.5943*
β_{RMW*DY}	2.1407*	5.3720	4.5575	11.2932	2.0574	-1.6383	10.2243	3.6365	-1.9686	6.1745	4.5774	0.5883	-4.1871**	0.8268
β_{RMW*TB}	-235.9709*	-26.6881	-154.8765	314.6978	-100.9501	-150.6622	-135.8696	-66.8267	-30.2412	-81.7037	-189.3930	-354.8285*	-28.7659	-48.1953
Adj. R^2	0.8242	0.3090	0.3172	0.6160	0.8029	0.8769	0.3903	0.6684	0.7975	0.3174	0.3107	0.7658	0.7687	0.7912
w1	0.5203	0.1387	0.3203	0.0482	0.5114	0.9234	0.3715	0.3052	0.5665	0.1868	0.0700	0.3154	0.7108	0.5007
w2	0.1077	0.0405	0.0729	0.0003	0.1956	0.0119	0.0290	0.1643	0.4679	0.0649	0.1579	0.0582	0.0000	0.8709
w3	0.1695	0.0351	0.1128	0.0005	0.2656	0.0145	0.0365	0.1968	0.5565	0.0746	0.1458	0.1126	0.0000	0.8630