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Are Green Investment Funds More Resilient During Crises? A Quantile Analysis of Performance Amidst COVID-19.

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Abstract

This study investigates the performance and resilience of green investment funds during the COVID-19 crisis, focusing on the integration of Environmental, Social, and Governance (ESG) criteria into investment strategies. Green investment funds aim to reconcile financial performance with sustainability goals by allocating resources to sectors such as renewable energy, green technology and ESG-compliant companies. The rise of green funds reflects a growing awareness among investors of environmental and social challenges, and a real appetite for responsible financial strategies. Unlike green bonds that finance specific projects, green funds provide a more comprehensive representation of sustainability trends across diverse sectors. The COVID-19 pandemic posed significant economic dsruptions, characterized by extreme market volatility, heightened uncertainty, and shifts in investor behavior. Evidence from past crises, such as the 2008 financial collapse, shows that socially responsible investment (SRI) funds demonstrated resilience due to their governance and risk management practices. During the pandemic, ESG funds similarly showed robust performance compared to traditional funds. Empirical analyses revealed that these funds benefited from their exposure to sectors like technology, healthcare, and renewable energy, which were less affected by the economic downturn.

However, not all green funds performed uniformly. High-yield ESG funds with investments in mature and innovative sectors exhibited superior resilience, whereas funds targeting riskier or transitioning sectors faced challenges. A key determinant of fund performance was government support policies. At the same time, international initiatives such as the Paris Agreement and the United Nations' Sustainable Development Goals have strengthened investor appeal for funds aligned with long-term environmental and social objectives. For instance, in Europe, the Green Deal and post-pandemic recovery plans bolstered green funds' performance by directly supporting energy transition sectors. The document adopts a methodological framework incorporating econometric models and panel data analyses to evaluate weekly fund returns. External factors, such as market volatility (measured by the VIX), oil prices, COVID-19 deaths, and unemployment claims, are included to explain variability in returns. Results from the panel regressions highlight that global stock market trends, proxied by the MSCI World Index, had the most significant positive impact on fund returns, whereas indicators like COVID-19 deaths and jobless claims showed limited statistical significance.

Keywords: Green investment funds; resilience; COVID-19; Least ordinary squares; Quantile regression;Paneld

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1 Introduction

Green investment funds, especially those focused on ESG (Environmental, Social and Governance) principles, have gained importance as sustainable financing instruments. They aim to reconcile financial performance with sustainability goals, responding to the growing need for financing for sustainable initiatives in the face of global challenges, such as climate change. However, their resilience in the face of global crises, such as the COVID-19 pandemic, raises questions about their performance in times of market volatility. Indeed, compared to green bonds, green investment funds offer a broader exposure to sustainability. They allow diversification into various sectors such as renewable energy, green technology and ESG-compliant companies.

This diversification makes green funds more representative of the full range of sustainability trends in the market, making them a relevant topic of study for understanding how sustainable finance responds to economic crises (OECD, "Green Investment Banks: Scaling up Private Investment"). During the COVID-19 pandemic, several studies have shown that ESG funds have outperformed their traditional counterparts. According to Broadstock et al. (2021), these funds benefited from their increased exposure to the technology and healthcare sectors, which were less affected by the recession.

The global urgency to mitigate climate change and embrace sustainable development has positioned Environmental, Social, and Governance (ESG) investment strategies as critical tools in modern finance. Green investment funds have emerged as a central element, focusing on sectors such as renewable energy, clean technology, and ESG-compliant industries. The need to evaluate their performance becomes particularly relevant in periods of economic volatility, such as the COVID-19 pandemic, which disrupted global markets and heightened investor uncertainty (Morningstar, 2020). During such crises, ESG funds have shown potential resilience due to their focus on governance, ethical principles, and long-term environmental goals (Friede et al., 2015).

These sectors accounted for up to 40% of the ESG portfolios analysed in their study, highlighting the importance of sector allocations in the stability of ESG funds. An analysis by BlackRock (2020) also found that more than 90% of sustainable indices outperformed their traditional benchmarks

in the first quarter of 2020, despite extreme market volatility. This result reflects a shift in mindset among investors, who are increasingly turning to strategies aligned with sustainability goals. Morningstar (2020) reported net flows to sustainable funds reaching $45.6 billion in the first quarter of 2020, a 50% increase from the same period in 2019, while traditional funds experienced massive outflows.

This highlights how green funds, which are more exposed to equity in terms of asset allocation, have shown greater resilience in the face of volatile markets. Indeed, green investment funds have been more resilient to periods of economic turbulence, as observed by Morningstar, which highlighted the outperformance of sustainable funds during the pandemic ("ESG and Resilience: How Sustainable Funds Have Outperformed During the Pandemic"). Moreover, work by Alessi et al. (2021) found that 35% of European institutional investors increased their allocations to ESG funds after the pandemic, perceiving them as less risky instruments and better aligned with emerging societal norms.

Cornett et al. (2020) also noted that investors in sustainable funds tend to maintain their positions over the long term, even in times of volatility, which allowed these funds to limit capital outflows, unlike traditional funds, which saw net outflows of up to 25% during the crisis. However, it is crucial to mention that green funds are particularly sensitive to government support policies. According to Boffo and Patalano (2020), 70% of ESG funds have benefited from the green recovery plans put in place to support the economic recovery from the pandemic, strengthening their resilience to economic shocks.

Empirical evidence indicates that green funds outperformed traditional ones during the pandemic, driven by strategic sectoral allocations in technology and healthcare—sectors less exposed to economic contractions (Broadstock et al., 2021). BlackRock (2020) highlighted that over 90% of sustainable indices outperformed their traditional benchmarks in Q1 of 2020, demonstrating the growing investor preference for ESG-aligned portfolios during turbulent times. Nonetheless, studies like Liang and Renneboog (2020) have raised concerns about the prevalence of greenwashing, whereby some funds falsely claim ESG credentials, creating a critical gap in understanding their true resilience. Furthermore, Nofsinger and Varma (2014) argue that socially

responsible funds tend to perform better during crises due to superior governance and risk management strategies, making this an essential area for research. Against this backdrop, this thesis addresses the following questions: How has the COVID-19 crisis affected the returns of green investment funds? To what extent have factors like market volatility (e.g., VIX), government recovery policies, and sectoral exposure influenced these outcomes? Are high-yield funds with advanced ESG integration inherently more resilient than their counterparts? These questions aim to deepen the analysis of ESG funds and contribute to sustainable finance research.

Despite these advantages, the issue of "greenwashing" remains a major issue for the integrity of green funds. Liang and Renneboog (2020) highlighted that almost 20% of ESG-labelled funds did not meet the announced sustainability criteria, raising concerns about transparency and governance in the assessment of these sustainable funds. Green investment funds cover a wide range of sectors and provide an opportunity to examine industry-specific responses to global crises, such as the one brought on by the COVID-19 pandemic.

Unlike green bonds, which finance specific environmental projects, green investment funds offer a more comprehensive view of sector performance and allow you to observe how sustainability trends are evolving at the market level. The COVID-19 pandemic has accentuated the importance of investing in more sustainable sectors, particularly renewable energy and green technologies, driving increased adoption of ESG funds (World Economic Forum, "Building Back Better: The Green Recovery Post-COVID").

This thesis contributes to the field of sustainable finance by providing a comprehensive understanding of how green investment funds perform during economic crises, specifically the COVID-19 pandemic. By examining the resilience of these funds in the face of extreme market volatility, the research sheds light on the effectiveness of ESG criteria as a tool for risk mitigation. The use of advanced econometric techniques, such as panel data regression and lagged variable analysis, ensures a robust examination of both immediate and delayed effects of external shocks on fund performance. This approach also enables a detailed evaluation of how sectoral compositions, such as exposure to renewable energy and technology, impact the stability and profitability of green funds.

The study’s findings have practical implications for fund managers, policymakers, and investors. By identifying key drivers of resilience, such as government policies supporting green recovery or specific sectoral focuses, this research can guide the formulation of strategies to enhance the robustness of sustainable investments. Additionally, it offers insights into the long-term viability of incorporating ESG factors into financial decision-making. By emphasizing the dual capacity of green investment funds to deliver competitive financial returns while addressing societal and environmental goals, the research underscores their critical role in promoting sustainability within the global financial ecosystem.

Thus, studying green investment funds and their performance during the COVID-19 crisis provides important insights into their resilience and the impact of ESG factors in investment strategies during periods of economic disruption (MSCI, "How COVID-19 is Affecting Sustainability"). The rapid growth of green investment funds in recent years, driven by regulatory frameworks and an increased awareness of climate-related financial risks, underlines their central role in sustainable finance (GSIA, "2020 Global Sustainable Investment Review").

2 Literature Reviews and Hypothesis

We present the research protocol through the identification of the problem, the formulation of the research objectives and hypotheses in the first section. In a second section, we will review the literature and present the research methodology.

2.1 Theoretical framework of the study

In this paragraph, it will be a question of understanding the subject through the problem, then setting the objectives and formulating the hypotheses of our study.

2.1.1 Foundations of Green Finance Amid the COVID-19 Crisis

The COVID-19 crisis was a major event that disrupted global financial markets and revealed the vulnerability of many asset classes to unforeseen economic shocks. During this period of extreme volatility, investors have faced unprecedented uncertainty, raising questions about how different asset classes behave in times of crisis. In particular, green investment funds, which integrate environmental, social and governance (ESG) criteria into their asset selection strategies, have gained prominence in recent years. These funds are seen as not only aligned with sustainability objectives, but also potentially more resilient to systemic risks, including those associated with environmental and economic crises.

Previous research has suggested that ESG funds, and more specifically, green funds, benefit from better long-term performance thanks to their proactive approach to climate and social issues. However, whether these funds are more resilient than traditional funds during global economic crises, such as the one triggered by the COVID-19 pandemic, remains largely open. The COVID-19 crisis, with its economic shocks, lockdown policies and repercussions on the global supply chain, offers an ideal context to analyse this issue. The impact of COVID-19 on green investment funds can be assessed through several dimensions: resilience to market volatility, exposure to sectors considered strategic for the energy transition (renewable energy, green technologies, etc.), and investors' receptivity to green recovery public policies.

A central question then emerges: did green funds outperform traditional funds during the crisis, and what factors played a decisive role in this dynamic? Green investment funds are designed to support projects that are environmentally friendly and aligned with the Sustainable Development Goals (SDGs) set by the United Nations. These funds invest in sectors such as renewable energy, energy efficiency, green transportation, and other technologies that reduce carbon footprints.

According to a study by Revelli et al. (2020), companies with strong ESG practices are likely to perform better over the long term, due to their ability to anticipate climate change risks and meet increasingly stringent environmental standards. In addition, an analysis by Morningstar (2020) showed that ESG funds outperformed their traditional counterparts during the COVID-19 pandemic, reinforcing the idea that these investments could offer better resilience in times of crisis.

The global health crisis of COVID-19 has led to exceptional volatility in financial markets. According to the VIX Volatility Index, often referred to as the "fear index", market volatility has reached record levels during the pandemic, with an increase of more than 250% compared to the historical average (CBOE, 2020). In this context, green funds have faced unique challenges, while benefiting from opportunities related to the green recovery policies adopted by many governments, particularly in Europe and Asia.

In Europe, the European Green Deal and the post-COVID recovery plan have positively affected the performance of green funds. According to a report by BlackRock (2020), sustainable equity indices outperformed their traditional counterparts, with a 3-5% difference in returns during the first quarter of 2020, despite a widespread fall in equity markets. These results have been largely supported by governments' focus on energy transition and climate resilience. This dynamic is explained by the fact that green sectors, such as renewable energy and clean technology, have continued to enjoy political support, making them more attractive to investors, despite the economic downturn.

Additionally, data from Morningstar (2020) revealed that net flows to sustainable funds reached a record $45.6 billion in the first quarter of 2020, a 50% increase over the same period in 2019.

This trend has shown increased investor interest in sustainable assets in times of crisis, which has contributed to the relative stability of green funds compared to traditional funds, which have seen massive outflows of capital during the same period.

However, the performance of green funds has not been uniform during the COVID-19 crisis. Research by Sullivan et al. (2021) has shown that high-yield green funds, which are typically invested in leading companies in the renewable energy and cleantech sectors, have significantly outperformed low-yielding funds, which are often invested in riskier or transitioning sectors.

In particular, funds with high exposure to technology and renewable energy sectors have outperformed more traditionally diversified funds. For example, the Global Clean Energy Index recorded a performance of +7.2% in 2020, while the S&P 500 Index lost around 10% during the same period (FT, 2020). This difference can be attributed to the strong demand for clean energy, supported by green recovery policies and a shift in consumer preferences towards more sustainable solutions.

To understand the differences in performance between green and traditional funds, it is crucial to analyze the specific factors that have influenced returns. Market volatility, as measured by the VIX index, was a major factor that affected all types of funds. However, green funds have shown greater resilience thanks to their exposure to sectors perceived as more stable over the long term, particularly those that are directly supported by public policies.

The unemployment rate and economic support policies have also had an impact on the performance of green funds. According to Reuter (2020), countries with stimulus packages that include green investments have seen a faster stabilization of their stock markets, particularly in the renewable energy sectors. For example, France injected €7 billion into the energy transition sector as part of its post-COVID recovery plan, contributing to the positive performance of its green funds.

This study will therefore aim to analyze the performance of green investment funds during the COVID-19 crisis, with a particular focus on the specific elements that have influenced their

returns. The pandemic, as an exceptional economic event, provides fertile ground to examine the extent to which these funds have been able to withstand extreme market volatility.

2.1.2 Research questions

In this study, we will try to answer the following three questions:

- Has COVID-19 affected the returns of green investment funds? And if so, how?
- Has the impact of COVID-19 differed between high-yield and low-yield funds? And how?
- Which factors (e.g., the VIX Volatility Index, jobless claims, MSCI World Index) have been the most significant and have had the greatest impact during this period?

2.1.3 General objective of the research

The overall objective of this study is to assess the resilience and performance of green investment funds during the COVID-19 crisis.

2.1.4 Specific research objectives

To achieve this objective, several specific objectives have been defined:

Obs1: Examine the performance of selected green investment funds during the COVID-19 pandemic, comparing them to traditional funds to assess their resilience in a crisis context.

Obs2: Analyze whether external factors such as market volatility (VIX), jobless claims, and COVID-19-related deaths explain the variability in green fund returns during the crisis.

Obs3: Assess the heterogeneity of the impact of the pandemic on different green funds using panel and regression data techniques to identify differences in resilience between high-yield and low-performing funds.

Research Hypotheses

A few hypotheses have been formulated to meet the specific objectives:

Hypothesis 1: Green investment funds have shown better resilience than traditional funds during the COVID-19 crisis, thanks to their exposure to sectors considered strategic for the energy transition and supported by supportive public policies.

Hypothesis 2: The performance of green funds has varied according to their exposure to sustainable sectors (renewable energy, green technologies, etc.), with an outperformance of high-yield funds, which are more invested in sectors perceived as more stable and resilient to crises.

Hypothesis 3: more pronounced for funds with a high exposure to energy transition sectors.

2.2 Measuring key concepts

2.2.1 Measuring the Performance of Funds

The performance measurement of investment funds is a cornerstone of financial analysis and asset management, serving as a tool for evaluating efficiency and guiding decision-making. Fund performance is typically assessed using metrics such as total returns, risk-adjusted returns, and relative performance benchmarks. Total returns represent the overall gain or loss of a fund, incorporating capital appreciation, interest, and dividends over a specified period. However, total returns alone fail to account for risk exposure, a critical determinant of investment success. Metrics like the Sharpe ratio address this limitation by assessing returns per unit of risk, making them widely recognized for evaluating funds' performance comprehensively (Sharpe, 1994).

Risk-adjusted measures, including the Sortino ratio and Treynor ratio, provide nuanced insights into performance. The Sortino ratio refines the Sharpe ratio by focusing on downside risk rather than total volatility, acknowledging that investors are primarily concerned with losses rather than fluctuations above the mean (Sortino & Van der Meer, 1991). The Treynor ratio, conversely, evaluates returns against systematic risk or beta, isolating the effect of market movements on fund performance. These tools allow for better understanding of how funds balance risk and reward, essential in periods of market turbulence.

Another approach involves benchmarking, where a fund's performance is compared to market indices or peer groups. This method provides context, helping investors determine whether fund managers are delivering value beyond what could be achieved through passive investments. Yet, issues such as the selection of an appropriate benchmark and survivorship bias-where underperforming funds are excluded from datasets—pose challenges to the reliability of comparisons (Brown et al., 1992).

Measuring fund performance is further complicated when incorporating Environmental, Social, and Governance (ESG) factors. ESG-oriented funds often face criticism for potential trade-offs between sustainability goals and financial performance. Yet, studies increasingly reveal that ESG integration does not necessarily compromise returns. In fact, Friede et al. (2015) conducted a meta-analysis of over 2,000 studies, concluding that approximately 90% observed a non-negative relationship between ESG criteria and financial performance. This underscores the role of ESG metrics as not only an ethical consideration but also a financial one.

Technological advancements have introduced sophisticated tools to enhance fund performance assessment. For instance, big data analytics and machine learning models offer predictive insights into market dynamics, enabling more accurate assessments of past and potential performance (Lo, 2017). Additionally, the increasing availability of real-time data facilitates more granular analysis, aiding both researchers and practitioners in their pursuit of optimal investment decisions. Despite these advances, challenges such as data quality, ESG standardization, and aligning measurement tools with investor objectives remain critical to address in modern fund analysis.

2.2.2 Financial Crises

Financial crises are defining events that expose vulnerabilities within financial systems, creating widespread economic repercussions. These crises are characterized by a sudden and severe contraction in market liquidity and asset prices, often precipitated by systemic risks or speculative bubbles. The 2008 global financial crisis serves as a prime example, triggered by the collapse of the subprime mortgage market in the United States. This crisis revealed the interconnectedness of global financial institutions and underscored the consequences of excessive risk-taking and inadequate regulatory oversight (Brunnermeier, 2009).

During financial crises, investors often adopt risk-averse behaviors, reallocating capital toward

perceived safer assets such as government bonds and commodities like gold. These shifts exacerbate market volatility, magnifying losses for equity-heavy portfolios. Green investment funds, characterized by their focus on sustainable sectors like renewable energy, present a notable case for resilience during such periods. Research by Nofsinger and Varma (2014) demonstrated that socially responsible investment (SRI) funds exhibited lower volatility and higher performance during the 2008 crisis, attributed to better risk management and governance practices. Similarly, ESG funds outperformed traditional counterparts during the early stages of the COVID-19 pandemic, benefiting from sectoral allocations in technology and healthcare, which were less susceptible to economic contractions (Broadstock et al., 2021).

The relationship between financial crises and fund performance is influenced by broader macroeconomic factors, including market volatility, unemployment rates, and government interventions. Indices such as the CBOE Volatility Index (VIX) serve as proxies for market uncertainty, often spiking during crises and correlating with increased fund outflows. For instance, during the COVID-19 pandemic, the VIX surged above 80, reflecting extreme investor anxiety, yet green funds attracted substantial inflows, demonstrating a shift toward ESG-aligned investments amid uncertainty (Boffo & Patalano, 2020).

Government responses play a crucial role in shaping the outcomes of financial crises. Stimulus packages, monetary policies, and regulatory reforms often aim to restore stability and confidence within markets. Post-crisis, measures such as the Dodd-Frank Act were enacted in the United States to curb systemic risks and enhance transparency within financial institutions. During the COVID-19 crisis, green recovery initiatives in Europe, such as the European Green Deal, further supported the performance of sustainable funds by providing direct incentives for investments in renewable energy and climate-resilient projects.

Despite these patterns, the impact of crises on green funds is heterogeneous, with variations arising from differences in fund structure, sectoral focus, and geographic exposure. Funds with significant allocations in nascent sectors or regions with less mature ESG infrastructures may

experience heightened volatility compared to their more diversified or developed counterparts. This variability highlights the importance of nuanced approaches to risk assessment and portfolio diversification, particularly for funds operating under sustainability mandates.

2.2.3 Green and Sustainable Finance

Green finance represents an evolving segment of the financial sector aimed at addressing environmental challenges by supporting low-carbon, resource-efficient, and socially inclusive growth. Its foundation lies in integrating sustainability into financial decision-making to align investments with long-term global objectives such as the United Nations' Sustainable Development Goals (SDGs). This approach extends to a broad array of instruments, including green bonds, green loans, and equity-based funds focusing on ESG factors.

The adoption of green finance reflects a recognition of the interconnectedness between environmental sustainability and financial stability. Companies that align their operations with ESG principles are often seen as better prepared to address risks such as climate change, regulatory changes, and shifting consumer preferences. A study by De Villiers and Maroun (2018) highlights that firms adopting ESG practices experience lower capital costs and improved access to finance, demonstrating how sustainability objectives align with financial benefits.

Sustainable finance gained prominence during the COVID-19 pandemic as a pathway toward economic recovery and climate resilience. Governments worldwide introduced stimulus packages emphasizing green initiatives, such as renewable energy development and energy efficiency upgrades. These measures not only reinforced the role of green finance as a tool for crisis mitigation but also accelerated the shift in investor priorities toward sustainable assets. For instance, Alessi et al. (2021) reported that 35% of European institutional investors increased their allocations to ESG funds post-pandemic, perceiving them as less risky and more

aligned with emerging societal norms.

Green funds provide a critical lens through which the evolution of sustainable finance can be assessed. These funds focus on sectors that contribute to global energy transitions, such as solar power, wind energy, and carbon capture technologies. Unlike traditional funds, green investment portfolios prioritize projects with measurable environmental benefits, thereby extending their impact beyond mere financial returns. However, challenges such as greenwashing—where funds falsely claim adherence to ESG principles—threaten the credibility of this growing market. Clearer regulatory standards and transparency measures are necessary to uphold investor trust and the integrity of green finance.

Technology also plays an integral role in advancing sustainable finance by providing tools for enhanced measurement, reporting, and decision-making. Platforms leveraging blockchain, artificial intelligence, and big data enable more accurate assessments of ESG criteria, addressing long-standing concerns regarding data reliability and standardization. Additionally, innovative instruments like tokenized carbon credits and sustainability-linked loans further demonstrate how technology intersects with green finance to drive tangible outcomes.

In conclusion, green and sustainable finance exemplify a paradigm shift within the financial system, emphasizing the symbiosis between economic growth and environmental stewardship. While challenges remain, the increasing alignment of financial markets with sustainability imperatives signals a broader recognition of the role finance must play in shaping a resilient and inclusive global economy.

2.3 Theoretical and empirical review

Historically, it is very difficult to date the first use of the concept of "green finance". However, we can trace the awareness of the link between ecology and economy. The beginning of global environmental awareness was marked by two important environmental events in 1972. In March, the Club of Rome, a think tank of scientists, economists, national and international

officials, and industrialists from 53 countries, published its first report, the Meadow Reports.

It questioned the benefits of growth and warned of its consequences for the environment and the foreseeable shortage of energy resources. The objective of this simulation is to predict the future economic and ecological state of the planet according to several criteria: fertility rate, soil fertility, stock of resources, impacts of pollution, growth rate... The researchers concluded that if the world population continues to live at its current rate and therefore needs to overexploit natural resources, this will result in a halt in growth and population.

Criticized at the time as a doomsday report, it is now seen as a pioneer in several respects. Since this report, many researchers have stated the same conclusions. Three months later, the United Nations Conference on the Human Environment was held in Stockholm. It was the first international community to organize such a conference on the environment. This event laid the foundation for the United Nations Environment Programme (UNEP), which was established at the end of 1972. These first efforts are the beginning of a global awareness and lead to many other initiatives.

Following this radical realization by the national governments, some companies also undertook environmental actions to support the operations. At the financial sector level, companies are called for a transition to a low-carbon and climate-resilient economy. The financial industry therefore takes responsibilities and has a major role in financing the energy transition by developing new financial instruments. The first green bond was 8 issued in the United States by the city of San Francisco to finance solar electricity. In 2008, the World Bank issued its first green bond in the face of a huge demand for green funding. In 2007, the European Investment Bank (EIB) issued the world's first Green Bond, labelled a Climate Awareness Bond (CAB).

This first type of bond allows banks to raise funds specifically for a type of project that meets the characteristics of a green investment. It marks the beginning of a new financial market

and introduces a new way of combining investment and ecology in our economy. The ecological transition is a very recurrent topic in our society. In a context where climate change is a very current and pressing issue, companies are getting more involved in the green transition.

A number of recent studies have highlighted the growing interest of investors in green investment funds. Thus, this type of funds has grown as an important part of the financial landscape, owing to increased awareness of environmental and social concerns of today's society. According to the article to A. Stankiewicz (2024) *"*ESG Funds' Performance Recovers From 2022's Lows" and global assets in green investment funds reached $2.3 trillion by the end of 2022.

In other words, between 2022 and 2023, there have been a 35% total increase. These funds strive to balance financial returns with beneficial environmental and social consequences, frequently including Environmental, Social, and Governance (ESG) factors into their investing strategy. This expanding trend reflects a larger shift toward sustainable investment, which is impacted by changing legislative frameworks, investor preferences, and corporate responsibility.

Green investment funds are primarily aimed at fostering sustainable development in combination with the pursuit of financial performance. According to the Global Sustainable investing Alliance (2019) the total assets managed through sustainable investing techniques reached $30.7 trillion at the start of 2018, marking a decent 34 percent rise in just two years. This steep rise indicates that ESG will find its way into investment decisions more and more often as a result of the powerful convergence of regulator pressures, consumer demand for corporate sustainability, and increased recognition of long-term benefits from sustainable their behavior when another economic crisis may hit, thus consolidating their reputation for stability in a context of financial volatility investing.

These changes underscore the key role that green investment funds can play in encouraging sustainable economic practices alongside competitive returns. Their performance has come under scrutiny despite their growth. At the very beginning, investors were strongly skeptical about including ESG factors in investing decisions and had a million doubts as to their influence on financial success. Now, with times changing in terms of reputation towards sustainable investing, proof of these funds' success has started to come through.

Friede, Busch, and Bassen (2015), presents a detailed assessment of the link between ESG criteria and financial success. Their meta-analysis, which included evidence from over 2,000 investigations, revealed that “Roughly 90% of studies find a non-negative ESG– CFP (corporate financial performance) relation.” Friede, Busch, and Bassen (2015) conclude that integrating ESG criteria into companies is beneficial to their performance. The majority of research linking performance to ESG criteria found a positive impact, implying that green funds are not only aligned with sustainability aims, but may also generate financial returns equivalent to or greater than those of standard investment funds. This research emphasizes the potential for green investment funds to provide both financial and societal advantages, hence increasing their value in modern investment portfolios.

Historically, green funds have been an innovation, but little tested in times of recession. However, it was the financial crisis in 2008 that proved to be a real acid test for green investment funds. According to Nofsinger and Varma, 2014, in an article Socially Responsible Funds and Market Crises," SRIs showed high resilience during this tormenting period. This was mostly as a result of investing in governance and risk management. Their good performance relative to traditional funds is explained by their perfect diversification and reduced exposure to high-risk sectors such as finance and real estate, which were most hit by the crisis.

This historical performance is important in that it provides a benchmark by which to frame how these funds might perform during future economic crises, such as the COVID-19 pandemic currently underway. The 2008 crisis was, in this respect, a significant test for

sustainability-focused investment strategies. It really does bear out the idea that putting governance and risk management into investments makes a stronger resilience facing financial turbulence. It has also shown that past performances of green investment funds during crises are imperative to plan Broadstock et al. (2021) examined the performance of ESG funds in the early phases of the pandemic, using Europe as a case study. Their “findings suggest that ESG funds, particularly those with significant investments in technology and healthcare sectors, exhibited resilience during the early stages of the COVID-19 pandemic, outperforming traditional funds”,
Broadstock et al. (2021).

ESG funds outperformed conventional funds during this period. Much of this relative resilience is directly tied to the sectoral allocations by ESG funds, which rather astutely favored industries such as technology and healthcare. These sectors have not been as negatively impacted by the economic contraction caused by the pandemic, and have served to pad some of the larger market instability affecting businesses of many other types.

The study has shown that investments in industry-specific companies are more important to the green funds crisis performance. It was no accident that ESG funds were resilient during the COVID-19 epidemic but rather a result of deliberate investment strategies in industries that had huge development potential and very low sensitivity to economic shock. In fact, "The superior performance of ESG funds during the pandemic can be attributed to their strategic focus on sectors less vulnerable to economic shocks, such as technology and healthcare. This deliberate sectoral allocation provided a defensive buffer, enabling these funds to not only preserve capital but also achieve positive returns amidst widespread market turmoil.", Broadstock et al. (2021). This sectoral advantage enabled green funds to remain stable and even grow while many regular funds faltered.

Green investment funds are a developing and more resilient section of the financial industry. The research demonstrates that these funds not only fit with sustainability aims, but also have

financial performance comparable to standard investing techniques. The history and current performance of these funds, particularly during economic downturns, lays the groundwork to comprehend their function and usefulness in both calm and tumultuous periods. More study is needed to better understand the influence of exogenous shocks, like as the COVID-19 pandemic, on the long-term viability and success of certain investment methods. As this sector of sustainable investing has evolved, so too has our knowledge of its performance characteristics.

The integration of ESG incorporation has changed with the development of both financial analysis and sustainability reporting. Just as green investment funds have proliferated, so too has a growing body of research into their financial performance. For instance, Statman and Glushkov (2016) evaluated the performance of a group of socially responsible mutual funds and discovered that while competitive in terms of returns, they generally had slightly higher expense ratios than conventional funds. This is illustrative evidence of the challenges of assessing green investment funds, for every indicator pointing to better performance comes with additional cost implications for the investing strategy.

The success of green investment funds has also been affected by industry-specific movements and determines regulatory changes worldwide. The renewable energy industry, by dint of international accords like the Paris Agreement, was a major source of development for such funds before the COVID-19 epidemic. Its excellent results would help further promote the general achievements that green investment funds were able to attain. De Villiers and Maroun's (2018) demonstrates how investments in clean energy sources have frequently resulted in favorable financial results for green funds. This research simply reiterates that in some sectors, there is a convergence of sustainability goals with financial returns; therefore, specific methods of investing in green funds are needed.

The historical performance of green investment funds demonstrates a complicated but progressively beneficial link between environmental, social, and governance requirements

and financial results. These funds have undoubtedly done quite well in terms of returns and withstanding economic shocks. This history of the funds, more characterized by expertise and sector-specific achievements, provides strong ground for analyzing current and forecasted performance. Continued study will yield even greater insight into the inner dynamics of green investment funds and their engagement with the greater financial markets as the discipline of sustainable investing evolves.

It is during times of economic crises that most of the investment strategies focused on sustainability get their most essential testing grounds. Financial stress has historically contributed valuable insights into the resilience and performance of green investment funds versus regular investment vehicles.

This resiliency is due to various elements built into green investment vehicles. In addition, an emphasis on excellent governance and socially responsible activities frequently results in a less risky and better managed investment strategy. These strategies, in particular, proved to be helpful during the crisis year 2008, as it helped mitigate certain of the risks related to market volatility. The crisis underlined a possible benefit in contemplating ESG considerations when setting investing methods by just those green funds' ability to provide stability despite the volatility of the broad market.

It is likely that the sectoral mix of many green funds helped them in some degree of resilience during the COVID-19 epidemic. Those sectors, such as technology and healthcare, which are overrepresented in ESG funds, were less hard hit by the epidemic compared to traditional sectors such as energy and industrials. Indeed, rebalancing focus toward sustainability and long-term resilience may have helped to boost investors' confidence in green funds during the pandemic, thereby boosting relative performance.

Nofsinger and Varma (2014) examine the performance of socially responsible funds during market crises, explicitly the 2008 financial crisis. The authors found that socially responsible

funds fared better than traditional funds, and assigned this to a great degree to governance and risk management practices. According to this study, these funds tended to keep their distance from very volatile sectors, which helped make them more relatively stable during economic downturns. Comparatively speaking, these crises indicate a general trend: green investment funds are resilient during times of economic hardship, though the detailed dynamics of the crisis could not have been alike.

The 2008 financial crisis and the outbreak of COVID-19 have shown rather some interesting insights into how green funds might adapt to impending economic problems. The two crises underline the need to decipher the drivers of green investment strategy resilience and potential benefits that can be reaped from including ESG criteria in investment decisions. Given the strong performance that such funds have had during the 2008 financial crisis and even the COVID-19 epidemic, their focus on governance, risk management, and industry diversity could be of value in financial settings as volatile as these (Nofsinger & Varma, 2014). Further research is required to identify how such funds work in relation to the heterogeneous crises that take place and what kind of long-term effects this elasticity gives rise to in terms of sustainable financing.

The COVID-19 outbreak made global financial markets record both volatility and uncertainty. Green investment funds were no exception to these enormous challenges. Preliminary assessments indicate that, although they have borne some market shocks, green investment funds have been more resistant than the regular investment funds. This resistance then allows for an assessment of how green investing strategies performed during a global economic crisis.

The initial stages of the COVID-19 pandemic caused unprecedented market volatility and widespread economic disruption. Amid these challenges, sustainable funds exhibited remarkable resilience. According to Morningstar (2020), global sustainable funds attracted $45.6 billion in net inflows during the first quarter of 2020, even as traditional fund markets

experienced significant outflows.

This influx of capital into sustainable funds reflects a sustained confidence in the long-term viability of green investments, suggesting that the underlying principles of environmental, social, and governance (ESG) investing may have played a role in stabilizing these funds during a period of heightened market uncertainty. Research from BlackRock (2020) similarly highlights how ESG-focused portfolios outperformed traditional ones during the pandemic's early months, pointing to growing investor demand for sustainability amid economic crises. Additionally, a study by MSCI (2020) noted that ESG funds' sectoral allocations—particularly in technology, healthcare, and renewable energy helped cushion them against the worst effects of market turbulence.

These patterns indicate a deeper, systemic shift in investor priorities, emphasizing sustainable investing as not only a moral imperative but also a viable strategy for mitigating risk during periods of severe market instability. As financial markets continue to face uncertainty, the inflows into sustainable funds underscore their role as a potential hedge against future economic shocks, aligning investor objectives with long-term sustainability goals (Financial Times, 2020).

The resilience of green investment funds during the pandemic may also be supported by changing investor sentiment. Amidst the pandemic, the global vulnerabilities and the necessity of long-term sustainability were unveiled, leading to massive adjustments in investing preferences in support of ESG factors. Investors started perceiving sustainable investing as a pathway to reduce risk and capture opportunities that better aligned with the rising social ideals. This shift in mood, as reported in a variety of research, including those by Alessi et al. (2021), suggests that the epidemic has hastened the emphasis on sustainability in investment decisions. According to the analysis, ESG funds in Europe outperformed conventional funds in part because they were less exposed to high-risk industries such as energy, which were worst impacted by the crisis.

Though, against the backdrop of these very encouraging overall outcomes, greenwashing concerns have been raised. If, in response to the pandemic, investor demand did start outpouring for ESG products, the related risk would have been that various funds were being labelled as sustainable when, in reality, they had substantially altered their investment process. In their 2020 study on *Corporate Social Responsibility and Sustainable Finance*, Liang and Renneboog address the rising concerns about the authenticity of ESG claims amid the rapid growth of green investments.

They highlight the risk of "greenwashing," where companies or funds may overstate their commitment to sustainability in order to attract ESG-conscious investors. The authors emphasize the need for greater transparency and the creation of clear benchmarks to ensure that investments marketed as sustainable genuinely meet the standards they claim to follow. This is especially important as the demand for ESG investments continues to rise, making it critical to maintain investor trust and uphold the integrity of sustainable finance.

The COVID-19 pandemic had a huge impact on worldwide financial markets, especially green investment funds. As the epidemic progressed, financial markets saw extraordinary volatility, which had diverse consequences for various kinds of investment funds. Green investment funds seemed to be more resilient than their regular equivalents. Initial investigations provide light on how these funds handled the economic upheaval caused by the epidemic.

As a result, green investment funds have tactically positioned themselves in sectors that address both environmental and social sustainability concerns, such as renewable energy, technology and healthcare. These sectors drove the performance of green funds during periods of economic stress like the COVID-19 pandemic. The following discussion elaborates on the role of sectoral composition in driving the resilience and performance of green investment funds during the pandemic, pointing out their strengths but also the possible vulnerabilities of such focused investment strategies.

One of the boosting sectors behind green investment funds is renewable energy. At a global

level, the shift to cleaner sources of energy remained unabated during the pandemic, while there were already economic slowdowns in other areas. This sector proved to be resilient and was further aided by government policies and investments as part of mitigating climate change. According to the *International Energy Agency (IEA)*'s *Renewable Energy Market Update 2020*, renewable energy was the only energy sector to experience increased demand during the COVID-19 crisis, largely driven by long-term power purchase agreements and government commitments to decarbonization.

This sustained demand has had a positive impact on green funds, which are significantly invested in the renewable energy sector. These investments provided a stabilizing effect against the wider downturns faced by traditional energy sectors, emphasizing the critical role renewable energy plays within green investment portfolios. The resilience of this sector highlights its strategic importance, particularly during global disruptions that impact conventional energy markets. The technology sector has also been part of many green investment funds and has done well during the pandemic.

Technology companies benefited from the accelerated demand due to increased reliance on digital solutions from both corporates and consumers through the lockdowns and social distancing measures. This sector often aligns with green investment goals because it is innovation- and efficiency-oriented, thus reducing environmental impact. In 2020, the World Economic Forum (WEF) in "Building Back Better: Harnessing the Power of Digital and Sustainable Transformation" explained that technology companies included in green funds not only weathered the pandemic but also performed exceptionally well due to their pivotal roles in facilitating remote work, digital health, and e-commerce.

The robust performance of these companies contributed significantly to the stability of green investment funds, reinforcing the notion that a sectoral focus on technology can offer resilience during economic downturns. This resilience is particularly evident when situations like the COVID-19 pandemic accelerate the broader digital transformation.

Healthcare is another principal sector of green investment funds, and the pandemic foregrounded attention to public health and medical innovation. The pandemic brought out strong resilience in the healthcare sector, where companies involved in this sector actively expanded services and products to fit the global health crisis. The World Health Organization (WHO) highlighted in 2021 ("Health Innovation and Sustainable Development") that investments in healthcare infrastructure and innovation played a crucial role in managing the pandemic.

Consequently, green funds with significant exposure to the healthcare sector naturally benefited from these developments. The WHO also emphasized that health and well- being are central to sustainable development, further elevating the importance of healthcare investments within green portfolios. The strong performance of healthcare stocks added another layer of stability to green funds, contributing to their resilience during a highly volatile market environment.

However, sectoral concentration in renewable energy, technology, and healthcare come with associated risks. While these sectors performed well during the pandemic, the overdependence on just a few of these sectors might make green funds more vulnerable to sectorial slowdowns in times to come. For instance, renewable energy, even while resilient, is still vulnerable to policy and technological changes. Likewise, while technology grew well, it has its issues related to changes in regulations and market saturation. The healthcare sector could also become volatile in the future again, it would depend upon the global health prospects and any changes in policy.

Therefore, sectoral focus has been a double-edged sword for green funds in their performance during the COVID-19 pandemic, thus putting forward the moral of diversification in order to mitigate risks associated with concentrated sector exposure.

The sectoral composition of green investment funds has significantly influenced their performance in the COVID-19 pandemic. It is in these sectors renewable energy, technology,

and healthcare that investments have endowed these funds with resilience to help them sail through the economic turbulence caused by the pandemic. At the same time, this reliance also underlines the potential vulnerabilities that could have an effect on the long-term sustainability of the green investment funds. Given the developing green investments market, fund managers will have to make a fine balance between sectoral focus and diversification to ensure that the funds remain resilient to future economic shocks.

Green investment funds are prominent not only for their competitive financial returns but also for their capacity to contribute to the broader societal goals of environmental sustainability and social equity. These include investment funds that integrate Environmental, Social, and Governance criteria, which can help determine investment performance during periods of market stress. The COVID-19 pandemic has been a critical test of the robustness that ESG-driven investment approaches have, laying bare both strengths and challenges of integrating these criteria into the investment decision.

Another important point about green funds is their long-term nature, which goes very well with the growing concern for corporate responsibility and stakeholder engagement. In companies with much ESG practice, crisis management was usually better during the COVID-19 pandemic. Eccles et al. researched the matter in 2021 and claimed that due to better stakeholder relations—employees, customers, suppliers firms with good ESG policies turn out to be more resilient during the pandemic. These relationships mattered in navigating pandemic disruptions to businesses, ensuring that companies could keep up operations and pivot as needed. Green funds invested in companies with deep ESG practices benefited from this resilience, underscoring the value of integrating ESG criteria within investment strategies.

Besides stakeholder relationships, governance practices have been another pivotal factor in the performance of green investment funds during the pandemic. Those companies that had a robust framework of governance were better placed in reacting to the fast-changing environment ushered in by the pandemic. The OECD's report mentioned earlier indicates that

firms with efficient governance structures had the advantage of speed in decision-making and were able to carry out crisis management strategies more rapidly and efficiently.

This was of greater significance during the early period of the pandemic when companies faced challenges that no business had ever encountered in history and had to really make fast decisions to save businesses. It means that the green investment funds that gave more precedence to governance as part of their ESG criteria were more likely to have their money invested in firms that could navigate the crisis effectively, and thus contributed towards the general resilience of these funds.

Integrating ESG criteria into an investment strategy presents challenges, particularly in the context of financial performance. While ESG-focused companies may demonstrate resilience during crises, this focus does not always guarantee superior financial returns, especially in the short term. Blitz and Fabozzi's study *ESG and Investment Performance* (2021) points out that although ESG considerations contribute to long-term value creation, they can lead to underperformance in certain market conditions. For instance, early in the COVID-19 pandemic, some green funds underperformed traditional funds because they lacked significant investments in sectors like consumer staples and pharmaceuticals, which saw temporary gains.

This underperformance highlights the need for green investment funds to strike a balance between achieving ESG goals and securing financial returns, particularly in periods of high market volatility. A significant challenge with ESG integration is the risk of "greenwashing," where companies or funds exaggerate their environmental and social responsibility efforts. The pandemic heightened scrutiny of ESG claims, as investors increasingly demanded greater transparency and accountability. The Global Sustainable Investment Alliance's 2021 *Global Sustainable Investment Review* highlighted growing concerns about the credibility of ESG claims within green funds, raising fears that this issue could erode investor confidence. This challenge underscores the need for more rigorous ESG evaluation and reporting standards to

ensure that green investment funds genuinely align with sustainable objectives while also delivering financial returns.

The ESG criteria kept green funds sailing in the hard times of the COVID-19 pandemic. The attention towards stakeholder relationships, governance, and long-term sustainability contributed a booster dosage to these funds for sustainability in the face of unprecedented challenges. Achieving ESG goals is not that easy, though; it is confronted predominantly with managing financial performance and avoiding greenwashing. These challenges need to be reviewed if Green Investment Funds are to remain a credible and efficient vehicle for promoting Sustainable Development in view of the changing green investment fund market. The experience of the pandemic has brought to the fore the importance of strong ESG practices at both the company and investor levels in building a more sustainable and resilient financial system.

Agoraki et al., "How has COVID-19 affected the performance of green investment funds?", based on the potential yet mixed resilience of the green funds during the pandemic, whereby some outperformed their traditional peers, though others proved to be vulnerable to market shocks. Our study follows up on theirs by using quantile regression to assess how systemic factors like the MSCI World Index and VIX impacted the performance of funds at different tiers. Notably, we find that higher-performing green funds were more sensitive to pandemic-related shocks, such as COVID-19 deaths. This adds nuance to Agoraki et al.'s findings by identifying specific vulnerabilities within the green fund spectrum.

The CBOE Volatility Index (VIX) is widely used as a real-time gauge of market volatility and investor sentiment. Often referred to as the "fear index," the VIX measures expected market fluctuations over the next 30 days and is closely associated with periods of heightened uncertainty (Whaley, 2000, *The Investor Fear Gauge*). The COVID-19 pandemic marked one of the most significant spikes in the VIX, illustrating the high level of uncertainty the market faced

during this global health crisis.

During March 2020, as the pandemic spread rapidly and while governments-imposed lockdowns, the VIX surged to record levels. In mid-March, the index spiked above 80, surpassing levels seen during the 2008 financial crisis (Baker et al., 2020, *The Unprecedented Stock Market Reaction to COVID-19*). This reflected the high degree of uncertainty among investors about the potential economic consequences of the pandemic. The volatility had widespread implications, particularly for investment funds, which were exposed to market fluctuations in varying degrees.

The relationship between the VIX and fund performance, especially for green and ESG-focused funds, has been an area of increasing academic focus. Several studies highlight how heightened market volatility affects fund returns and overall performance during crises. The central argument in these studies is that during periods of high market volatility, uncertainty pushes investors to reallocate capital toward safer assets, impacting the performance of riskier investments, including green investment funds.

Starting from the Modern Portfolio Theory (Markowitz, 1952), as volatility increases, investors tend to shift from higher-risk equities to safer assets such as government bonds or gold. This behavior can drive down the performance of equity-oriented funds, which are typical in green investment portfolios (Elton, Gruber, Brown & Goetzmann, 2014,). However, it is also observed that some ESG funds exhibited resilience during the pandemic.

A paper by Bollen (2007), showed that socially responsible investment (SRI) funds, which are closely related to green funds, are sensitive to market volatility but also experience inflows during crises as investors seek sustainability. The performance of funds during the pandemic varied significantly. ESG and green funds often performed better than their non-ESG counterparts during the market turmoil of 2020 (Nagy et al., 2020, According to a Morningstar report, ESG funds showed a high degree of resilience, outperforming traditional funds in both

US and European markets during the height of the pandemic (Morningstar, 2020, *Sustainable Funds Weather the Market Storm*).

One explanation is that many ESG funds were more concentrated in sectors that fared relatively well during the pandemic, such as technology, healthcare, and renewable energy (MSCI, 2020, *ESG and the Resilience of Public Equities in 2020*). These sectors were less impacted by the immediate economic downturn, allowing green funds to maintain stability even during high volatility.

Several studies investigate the correlation between the VIX and the performance of green investment funds. Generally, higher VIX values correspond to periods of increased risk aversion, which can negatively affect riskier equity-based funds. However, the resilience of green and ESG funds during COVID-19 challenges the notion that all equity-heavy funds suffer equally during volatility spikes. Traditionally, higher VIX levels are negatively correlated with equity fund performance due to the increased uncertainty that leads investors to flee riskier investments (Brogaard & Detzel, 2015).

During the 2020 pandemic, the VIX surged, coinciding with massive drops in global stock markets. This generally resulted in negative returns for traditional equity funds. However, the effect of the VIX on green investment funds was less straightforward. Studies by Nofsinger and Varma (2014,) found that while ESG funds tend to underperform in normal market conditions, they often outperform during periods of crisis. This "flight to quality" in times of high volatility could explain why some green funds, despite being equity-heavy, fared well during the pandemic-induced VIX spike. Green funds, particularly those heavily invested in sectors like renewable energy and technology, showed unexpected resilience during the pandemic.

Research conducted by BlackRock (2020) highlighted that over 90% of sustainable indexes outperformed their parent benchmarks during the first quarter of 2020, despite the VIX reaching extreme levels. This was due in part to their sector allocation and focus on companies

with robust ESG practices, which tended to be less volatile. Lins, Servaes, and Tamayo (2017) suggest that during times of crisis, companies with stronger social and environmental practices tend to enjoy more investor trust, leading to better performance. This could partly explain the resilience of ESG funds during the pandemic despite the increased volatility measured by the VIX.

One lesser-discussed but essential factor is the influence of the VIX on fund flows. Research indicates that when the VIX rises, investors generally move away from riskier assets, resulting in equity fund outflows. Interestingly, during the pandemic, inflows into ESG funds increased, even with an elevated VIX (Boffo & Patalano, 2020). Fund flows are another key focus, as Baker et al. (2020) observed record inflows into green and ESG funds in 2020, despite significant market volatility.

This shift from typical trends can be attributed to rising investor confidence in the sustainable investment's long-term advantages. As the VIX rose, investors viewed green funds as safer options compared to traditional equities, instead of pulling back from them. Additionally, Cornett et al. (2016) suggest ESG investors generally have longer investment timelines and are less likely to react to short-term market fluctuations. This behavior could lessen the usual negative correlation between the VIX and equity fund performance, allowing ESG funds to continue attracting capital even in high-volatility periods.

There is also evidence suggesting that the VIX’s influence on green fund performance may not be immediate. Some studies have noted lagged effects, indicating that volatility may take time to fully affect fund returns. Wang and Li (2021) found that volatility in green assets, as measured by the VIX, often had delayed effects on fund performance, reflecting investors' initial hesitancy to abandon ESG-focused funds. This lag might suggest that while other asset classes experience rapid impacts from VIX spikes, ESG funds may be affected later or less severely.

Conversely, our study will apply statistical and econometric techniques to a dataset. Therefore, let's explore the existing literature on quantitative methods used in Fund Performance Analysis.

Ordinary Least Squares (OLS) is one of the most widely used statistical techniques in financial analysis. OLS is a linear regression method that estimates the relationship between a dependent variable and one or more independent variables by minimizing the sum of the squared differences between observed and predicted values (Wooldridge, 2010).

In financial analysis, OLS is often employed to model the return of assets or funds as a function of various explanatory factors, such as macroeconomic indicators or market risk factors. The main advantage of OLS is its simplicity and interpretability. By rates, influence financial returns (Brooks, 2014). However, OLS has limitations when dealing with more complex relationships, especially when heterogeneity is present across different data samples, such as in financial panels where fund characteristics can vary substantially over time and across entities.

In the context of green investment fund performance during the COVID-19 pandemic, OLS can provide insights into the average effects of variables such as market volatility (measured by the VIX), COVID- related indicators, and other macroeconomic variables (jobless claims) on fund returns. However, as financial markets reacted differently at different times during the pandemic, relying solely on OLS could miss key dynamic and heterogeneous effects across funds (Stock & Watson, 2015,).

This is why panel data methods, also known as longitudinal or cross-sectional time-series techniques, extend traditional regression by accounting for both individual (cross-sectional) and time-series dimensions in the data (Baltagi, 2008). In the context of fund performance, panel data allows the researcher to track multiple funds over time, which is crucial for understanding how each fund reacted to the evolving conditions during the COVID-19 pandemic. Panel data methods offer several advantages over standard OLS in this study.

First, the control for unobserved heterogeneity, i.e. fund-specific characteristics that do not vary over time, such as management style or investment philosophy, (Hsiao, 2003), an important feature when studying green investment funds, as they may have inherent features that influence their resilience or vulnerability to market shocks like the COVID-19 pandemic. Secondly**,** by relying on both cross-sectional and time-series data, panel data methods increase the efficiency of estimates and provide more robust results. This is particularly beneficial when dealing with financial data where the sample size for a single time period may be small, but pooling observations across funds and time can lead to more reliable estimates (Arellano, 2003).

One of the key strengths of panel data methods is their ability to capture dynamic relationships, such as how past fund performance or market conditions affect future returns (Wooldridge, 2019). This is especially relevant when analyzing the COVID-19 pandemic, where the impact of variables like COVID deaths or volatility may unfold gradually over time rather than immediately. In this study, panel data allows us to capture both the time-assuming a linear relationship between variables, OLS allows straightforward inferences about how different factors, such as market volatility or interest varying effects of COVID-19 related shocks and market volatility, as well as the fund-specific factors that influence performance.

The lagged effects mentioned before can be captured in regression analyzes: we can take into account the delayed impact of an independent variable on the dependent variable. In financial analysis, it is common for certain economic or market events to have a delayed influence on fund performance due to factors such as investor reaction times, gradual policy implementation, or slow-moving macroeconomic effects. In the context of the COVID-19 pandemic, variables like COVID-19 deaths or jobless claims may not immediately influence fund returns, but their effects could materialize with a time lag as investors reassess risks and adjust their portfolios.

Lagged effects analysis is particularly important in this study: it captures the gradual impact of the COVID-19 pandemic, with different stages of impact. For example, the initial market

reaction to the pandemic may be driven by fear and uncertainty (measured by the VIX), but the full economic impact may only be felt after prolonged lockdowns or rising unemployment, as reflected in lagged variables like jobless claims (Baig et al., 2020). Including lagged variables in the model capture these delayed responses, but also the delays with which investor responses to market signals and economic indicators occur. Research has shown that fund managers may take time to rebalance portfolios in response to changing market conditions, particularly during periods of heightened volatility (French & Roll, 1986).

Here, in green investment funds, which implies longer-term focus, the response to economic indicators such as COVID deaths or jobless claims may not be immediate. Also, variables used in the analysis, such as COVID-related deaths or jobless claims, are de facto proxies for broader economic risks. The impact of these variables may take time to flow through the economy and influence fund returns, as governments and central banks implement policies to mitigate the effects of the crisis (Baker, S.R., Bloom, N., Davis, S.J., Kost, K.J., Sammon, M.C., & Viratyosin, T., 2020). Lagged effects analysis helps to account for the time it takes for these policies to impact the financial markets.

Last, quantile regression has gained increasing attention in financial literature for its ability to provide a more nuanced analysis of the relationships between variables, especially if there is heterogeneity across different segments of the dependent variable distribution (Koenker & Bassett, 1978). Unlike Ordinary Least Squares, which estimates the average effect of independent variables on the dependent variable, quantile regression allows the analysis of effects at various points in the outcome's distribution, such as at the median or other quantiles.

This method proves particularly useful in financial studies where market performance can vary widely across different percentiles (Koenker, R. (2005). In green investment funds, for instance, quantile regression enables the investigation of how different market forces impact funds that are performing at different levels whether they are top performers or underperformers. For example, studies have shown that in volatile markets, the impact of

variables like the VIX, or CBOE Volatility Index, tends to vary significantly across different quantiles of fund performance (Zhang et al. 2020). Some funds may exhibit resilience under market stress, while others suffer considerably, making quantile regression a valuable tool to capture these differences.

Another advantage of quantile regression is its robustness in dealing with extreme market events. During times of crises, such as the COVID-19 pandemic, market returns often exhibit extreme volatility, leading to skewed results in traditional OLS estimates (Baur & Dimpfl, 2021). In contrast, quantile regression can better account for these extremes by examining how different segments of the market are impacted, such as the top and bottom-performing funds. For instance, while OLS might suggest that green investment funds have a moderate average response to market volatility, quantile regression can reveal that top-performing funds are less affected by shocks, whereas lower- performing funds are disproportionately impacted.

In the context of financial markets, this method is particularly valuable when studying variables like the VIX, oil prices, or macroeconomic indicators, which have been shown to affect different types of funds in diverse ways (Tsai, 2014). The application of quantile regression enables to uncover non-linear relationships and heterogeneity in fund responses to external factors, which is adequate for examining significant datasets involving financial returns under different market conditions.

3 Methodological framework of the study

3.1 Methodological approach

The impact of the pandemic on markets is measured using the number of COVID-19-related deaths. The sources are health databases like the *Johns Hopkins University Coronavirus Resource Center* and the *World Health Organization (WHO)*.

The market environment indicators are the CBOE Volatility Index (VIX) and the MSCI World Index. The latter is used as a proxy for global equity market performance. Data for the two data indices are sourced from *Yahoo Finance*.

The macroeconomic indicators are the US jobless claims and oil prices, here the West Texas Intermediate crude oil (WTI). The former is obtained from the *FRED Economic Data* and the latter from *Yahoo Finance*.

For the study, we chose to incorporate the returns of six green investment funds, that have been chosen to provide a diversified sample that covers different regions, fund Asset Under Management (AUM), and investment strategies. The combination of equity and bond funds also ensures a broad perspective on how green investments have performed during and after the COVID-19 pandemic.

The three investment geographical focuses are: Global, the US, and Europe. Indeed, for emerging markets, particularly in Asia, despite growing efforts in adopting sustainable practices, the green investment infrastructure in these regions is still developing. There is less regulatory oversight, fewer established ESG benchmarks, and fewer companies with long-standing commitments to ESG principles compared to more developed markets in Europe and the U.S. Additionally, ESG disclosures in emerging markets are not as robust nor transparent.

Given these considerations, focusing on markets where green investment funds are more

mature ensures a more reliable and consistent dataset for this study. Moreover, companies in these regions are subject to stricter environmental regulations and have larger pools of assets under management that are dedicated to sustainable finance, making them better suited for analyzing the impact of market volatility and crises like COVID-19 on fund performance. This exclusion helps to maintain comparability across the funds being analyzed and ensures that the funds' exposure to green investments is based on well-developed and transparent ESG frameworks.

Table 1: Selection criteria for Green Investment Funds

Criteria	**Recommended Threshold**
AUM	$50 million – $10 billion
Fund Age/Track Record	Minimum 3-5 years of data
Fund Type	Include both mutual funds and ETFs
Geographic Focus	Mix of global and regional funds (Global, U.S., Europe)
Sector Exposure	Diverse sectors
ESG Rating	High ESG or sustainability rating
Liquidity	Funds with high trading volume and accessibility

The period of study will span from **January 2018 to December 2022**, encompassing pre-pandemic, pandemic, and post-pandemic phases to capture a broad spectrum of market conditions and fund performance trends.

In the next page, we present an overview of the chosen funds, with the charts of their weekly returns over the time range: 04/01/2018 to 25/12/2022 (based 100 as of 04/01/2018).

Thorough analysis and details of the fund are available in the Appendix section.

3.2 Global funds

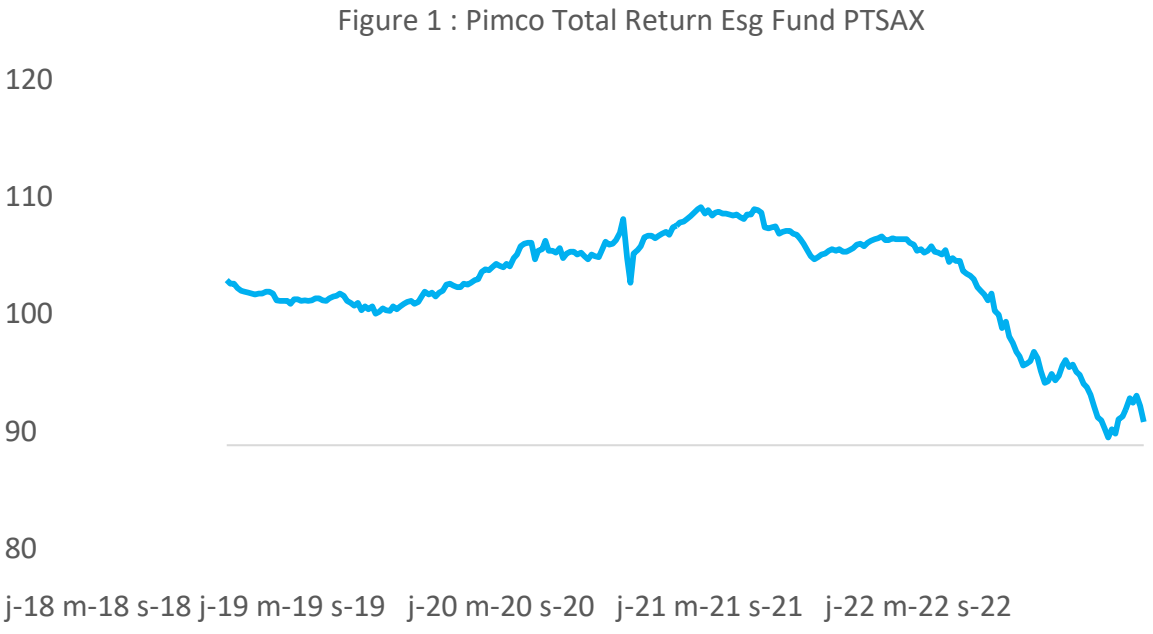
PIMCO Total Return ESG Fund

Geographical Focus: Primarily invests in U.S. securities, with exposure to global markets.

AUM: This fund is one of the largest ESG bond funds, managed by PIMCO, a leader in fixed income investing. Size as of 31/08/2024 is $ 7bn.

Strategy: A fixed-income fund focusing on ESG criteria, investing in bonds that promote sustainability while aiming to deliver competitive returns.

Figure 1: Evolution of the Weekly Returns of the PIMCO Total Return ESG Fund PTSAX over the study period.



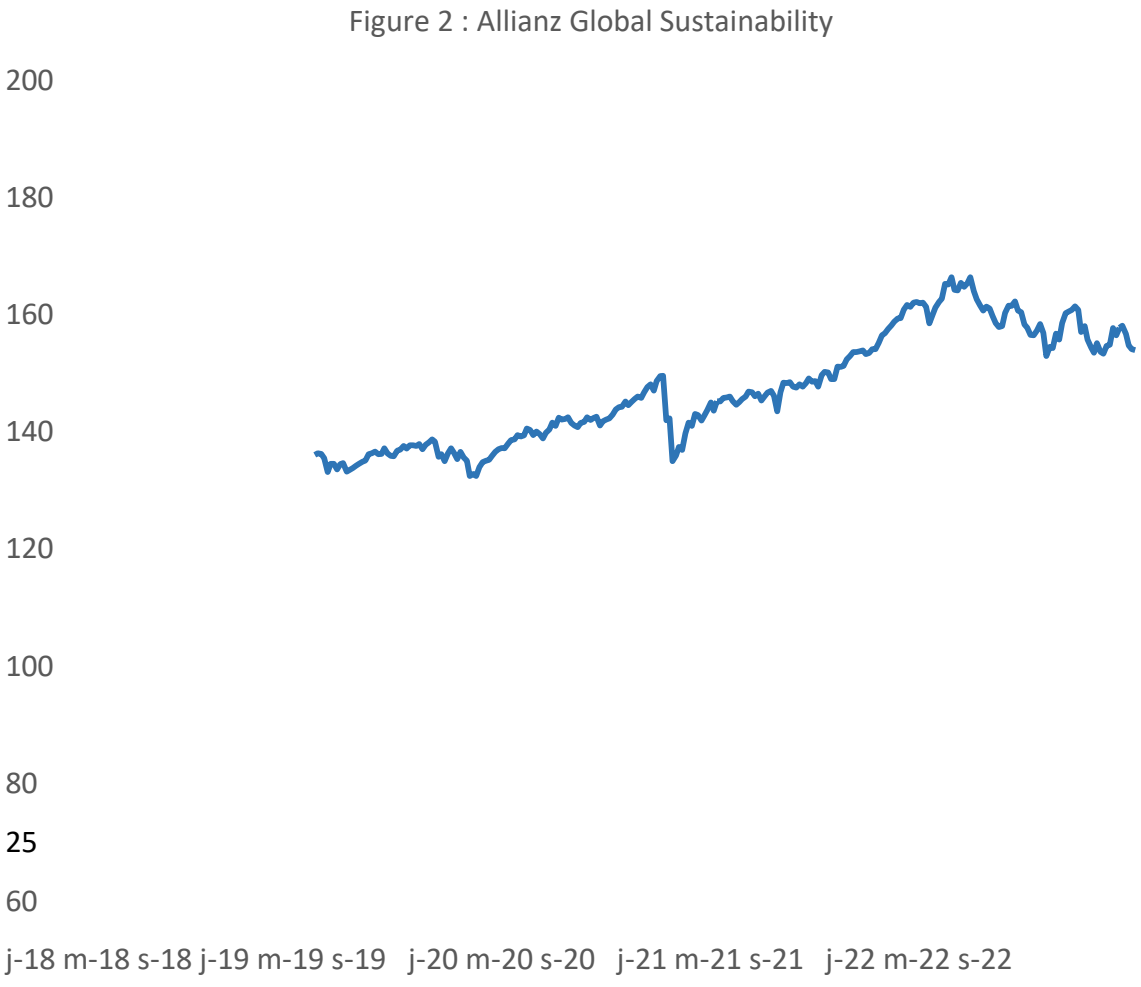
Allianz Global Sustainability Fund

Geographical Focus: A global focus, investing in companies worldwide.

AUM: Medium to large-sized fund, part of Allianz's broad portfolio of sustainability-focused funds. Size as of 31/08/2024 is $ 1.6bn.

Strategy: Primarily invests in companies with strong sustainability profiles, balancing financial returns with ESG considerations. It targets equities and companies working toward global sustainable development.

Figure 2: Evolution of the Allianz Global Sustainability Fund's Weekly Returns over the study period.



US FUNDS

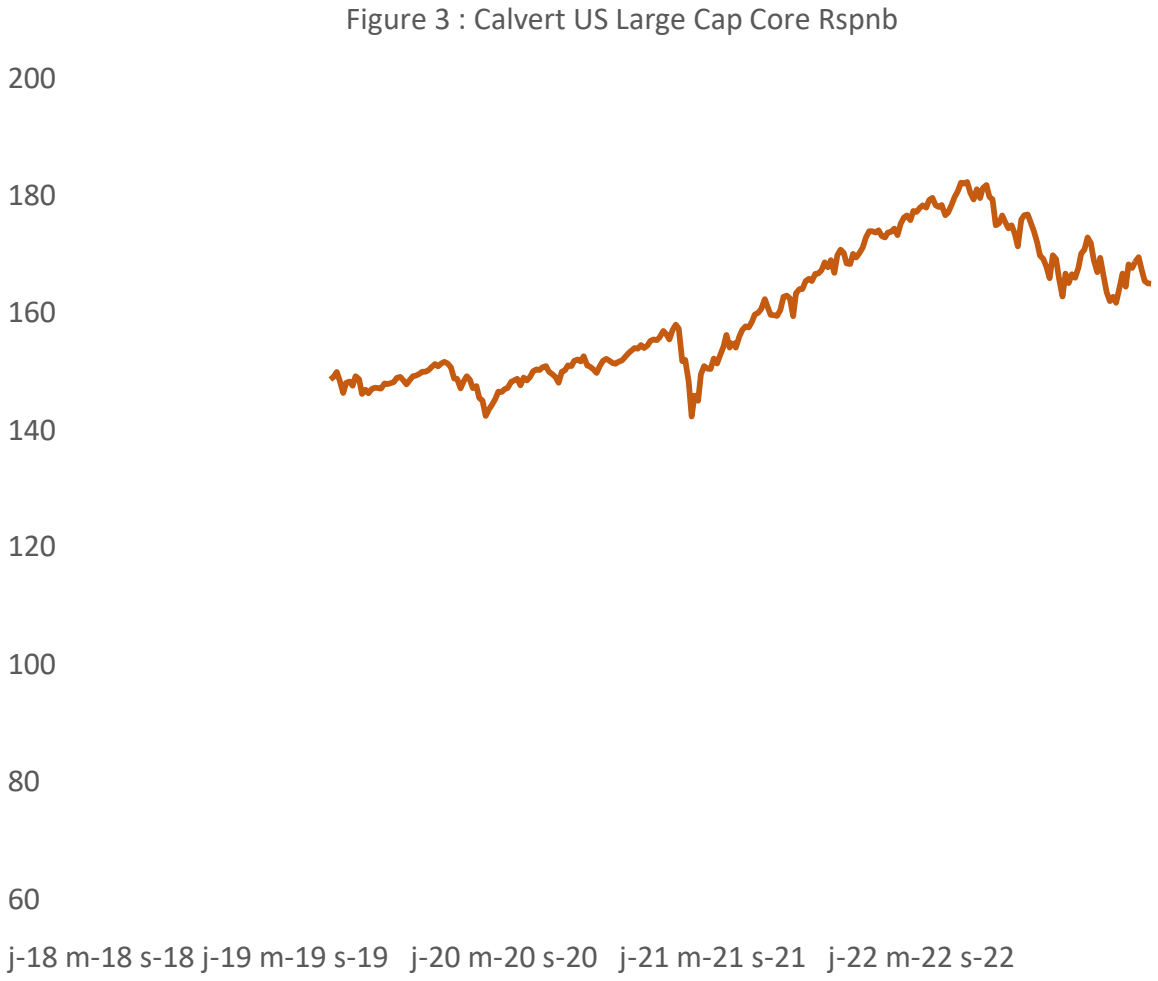
Calvert US Large Cap Responsible Index Fund

Geographical Focus: US-based, focusing on large-cap companies.

AUM: A well-established fund with a significant AUM of $ 4.5bn.

Strategy: This fund follows a index-replication strategy as it tracks a the Calvert responsible investment index, thus investing in large U.S. companies that meet specific ESG criteria.

Figure 3: Evolution of the Weekly Returns of the Calvert US Large Cap Core Responsible Fund



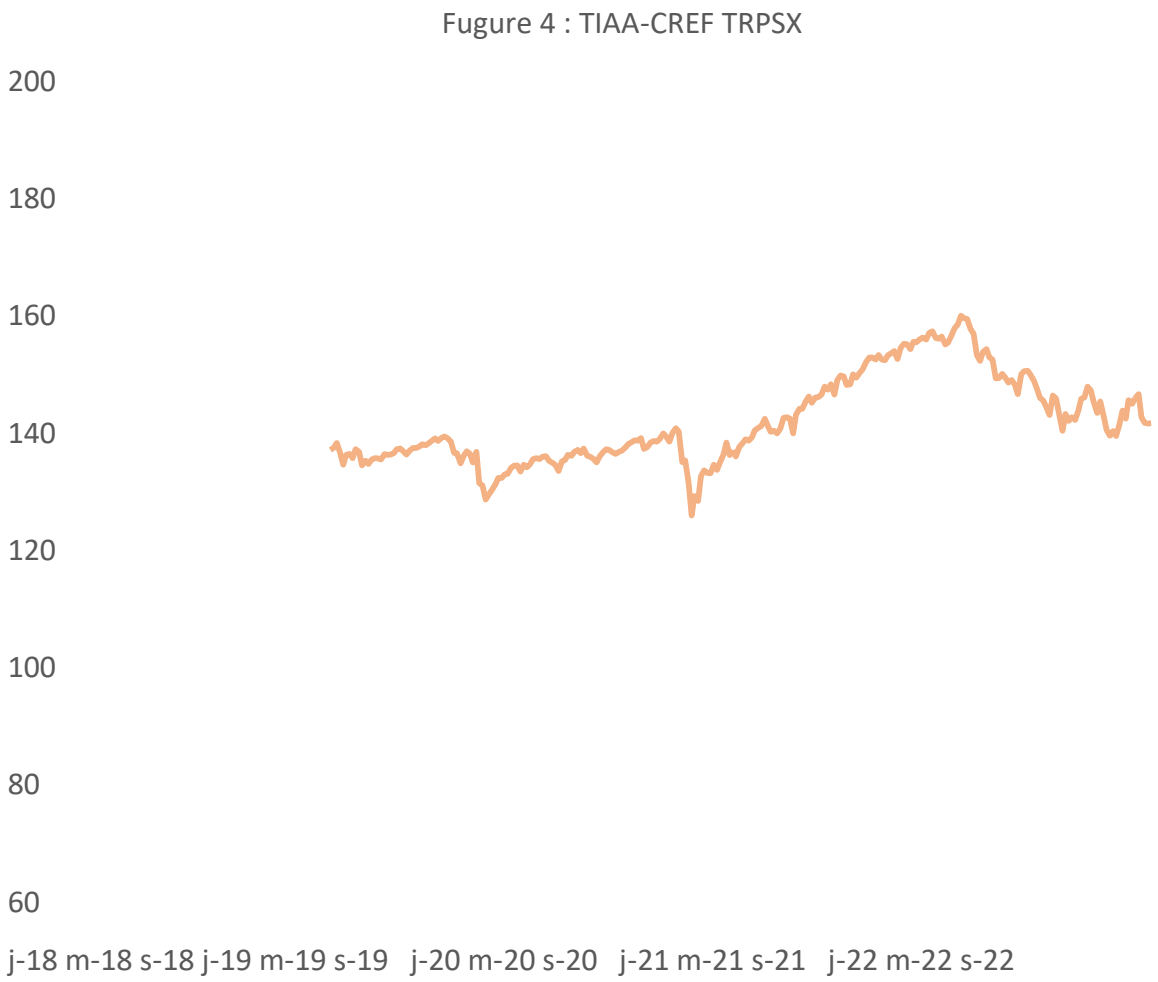
TIAA-CREF Social Choice Bond Fund

Geographical Focus: U.S.-focused, with selective international exposure.

AUM: A well-regarded fund within TIAA's SRI in-house range of funds. AUM of $ 3.8bn.

Strategy: Aims to generate fixed-income returns by investing in bonds that align with socially responsible objectives, focusing on bonds promoting social go

Figure 4: Evolution of the Weekly Yields of the TIAA-CREF TRPSX



EUROPE

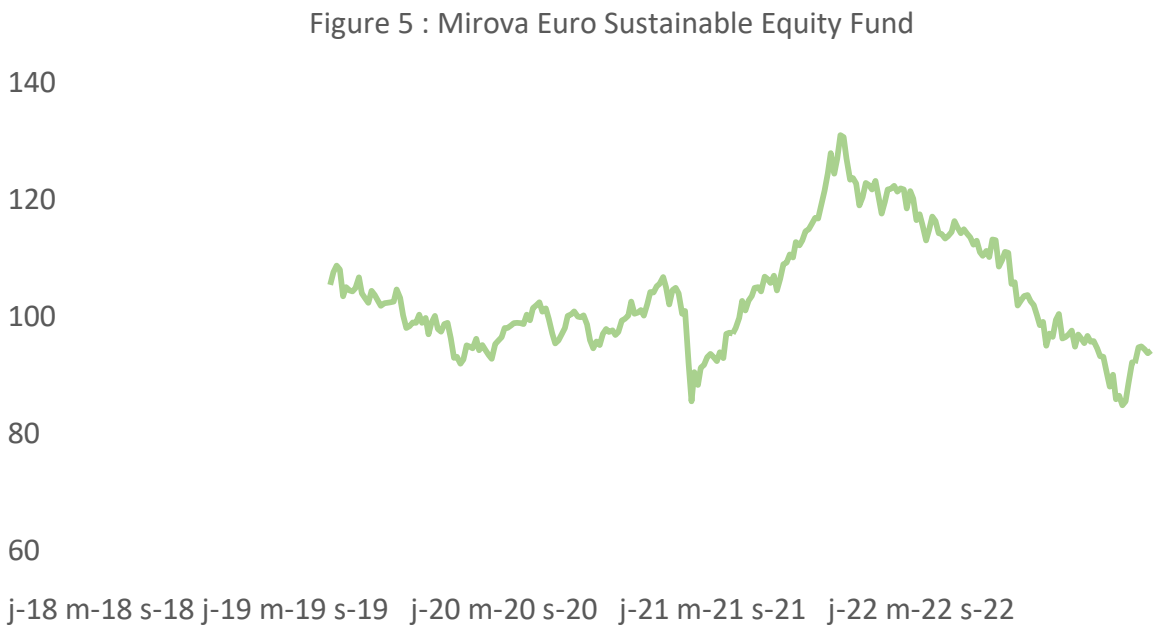
Mirova Euro Sustainable Equity Fund

Geographical Focus: Europe, with an emphasis on companies based in the eurozone.

AUM: Key fund managed by Mirova, a leader in sustainable finance. AUM of $ 2.7bn.

Strategy: This equity fund invests in companies within Europe that demonstrate leadership in sustainability and corporate responsibility.

Figure 5: Evolution of the Weekly Returns of Mirova Euro Sustainable Equity Fund



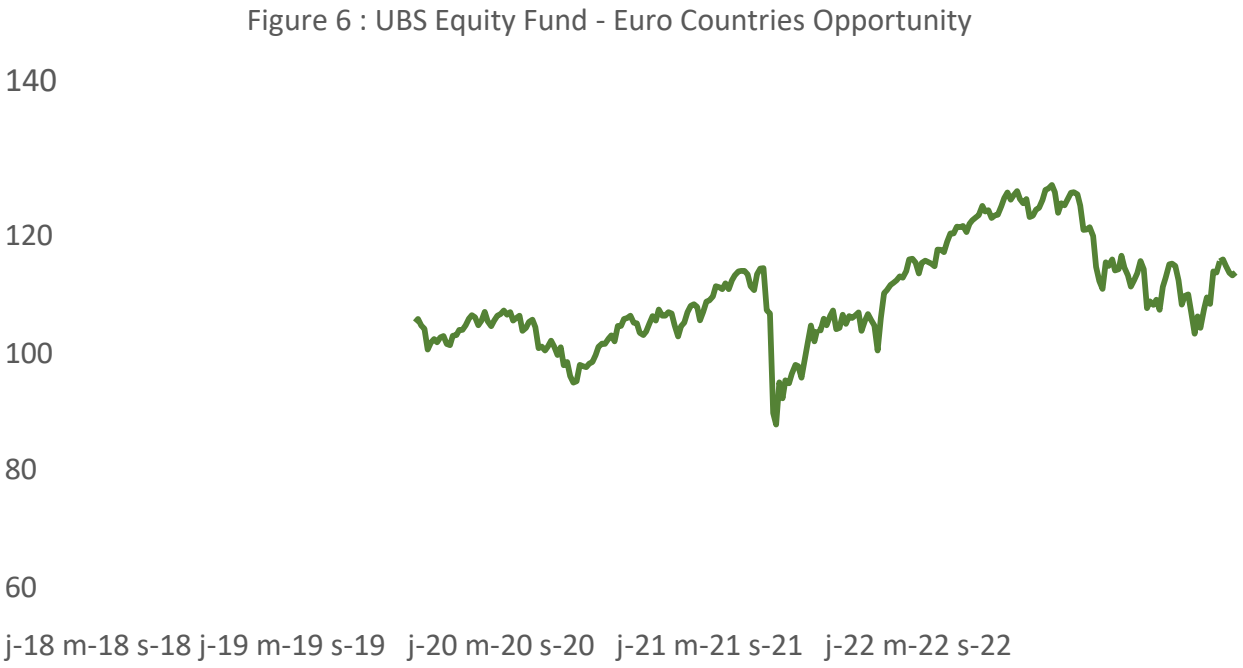
UBS Equity Fund – Euro Opportunity Sustainable

Geographical Focus: Primarily European equities, with global sustainability as a theme.

AUM: A significant player in UBS's sustainable investment portfolio. AUM of $ 950m

Strategy: This fund focuses on companies offering sustainable solutions and innovations within Europe, targeting long-term capital growth alongside positive ESG impacts.

Figure 6: Evolution of Weekly Returns of UBS Equity Fund – Euro Countries Opportunity



In this study, we chose to use weekly data because it provides a suitable middle ground between capturing detailed market movements and reducing the excessive fluctuations often seen in daily data. During the COVID-19 pandemic, financial markets were extremely volatile, with daily data sometimes too erratic to identify meaningful trends. Weekly data, by aggregating daily figures, smooths out some of this noise while still allowing us to track important short-term changes. This balance is crucial for understanding how variables shifted over time without losing sight of significant patterns.

The choice of weekly data is particularly relevant when studying market volatility, reflected in the **VIX (CBOE Volatility Index)**, which responds quickly to changes in investor sentiment and external shocks. The pandemic caused frequent shifts in the VIX, and using weekly intervals allows us to capture these variations without overemphasizing short-lived fluctuations, as daily data might. On the other hand, using monthly data would risk glossing over key movements, making weekly intervals a more effective choice for analyzing the relationship between market volatility and fund performance.

Additionally, the dynamics of the **COVID-19 pandemic** further support the use of weekly data. Key indicators like **COVID-19 deaths** and **jobless claims** showed significant variation from week to week, reflecting the evolving severity of the pandemic and its economic impact. By using weekly data, we can track how these factors influenced financial markets and the performance of green funds in a timely manner. This frequency allows us to see immediate effects without getting bogged down by daily noise, which may obscure the broader trends at play.

Moreover, financial variables such as **fund returns**, **WTI oil prices**, and the **MSCI World Index** are typically reported on a daily or weekly basis. By choosing weekly data, we align these variables and ensure that they are consistent across the dataset. This synchronization is essential to maintain coherence between the different financial and economic factors, preventing timing mismatches that could distort the analysis.

Weekly data also enables us to explore potential **lagged effects**, such as delayed responses in fund performance to changes in COVID-19 deaths or market volatility. If the impact of these variables does not happen immediately, weekly intervals are well-suited to capture these delayed responses. Using longer intervals, such as monthly data, could miss the timing of such effects, while daily data may introduce unnecessary variability, making it harder to identify meaningful trends. Weekly data provides the right level of detail to examine these shifts effectively.

3.3 Variables

The dependent variable for this study is the **weekly returns of green investment funds**, which reflect the performance of the funds. These returns are calculated using the closing prices of the funds on a weekly basis.

To assess how various external factors influence fund performance, we integrate several variables into the analysis:

The first variable, **COVID-19 Deaths**, is measured on a weekly basis and reflects the severity of the pandemic. The second one is the **VIX (CBOE Volatility Index)**. We chose to also incorporate the **US Jobless Claims**, which track weekly initial unemployment claims as a macroeconomic indicator, as GDP figures are calculated quarterly and do not present this level of granularity. A rise in claims can signify deteriorating labor market conditions, further contributing to economic instability and potentially influencing investor behavior.

Additionally, **WTI Oil Prices** are included to account for fluctuations in energy prices. Changes in crude oil prices potentially generate shifts in global economic conditions and investor sentiment, hence influencing the performances of the funds. The **MSCI World Index** represents global equity market performance. A positive movement in this index is generally associated with improving market conditions, which can boost the performance of green investment funds. Lastly, we introduce **Lagged Variables** by one period, (t-1) for both COVID deaths and US jobless claims. These lagged indicators allow us to examine whether the effects of the pandemic and economic downturn manifest in fund returns over time, capturing a potential delayed market reaction to these external shocks.

3.4 Methodology for Classifying Funds as "Green"

The process of classifying funds as "green" relies on comprehensive analysis leveraging quantitative and qualitative techniques. These methodologies aim to assess the adherence of funds to Environmental, Social, and Governance (ESG) principles, ensuring that only those demonstrating measurable sustainability practices are labeled as green. The classification begins with data collection, followed by the application of advanced statistical tools, including quantile regression and Ordinary Least Squares (OLS) regression, with careful justification for the choice of methods.

3.5 Data Collection and Preparation

The initial stage involves curating a dataset that captures ESG-related metrics alongside

financial and operational characteristics of funds. Data sources include MSCI ESG Ratings, Sustainalytics, and other industry-standard providers. The selected metrics span three dimensions:

- **Environmental**: Carbon footprint, renewable energy use, and waste management.
- **Social**: Employee diversity, community engagement, and labor standards.
- **Governance**: Board diversity, transparency, and ethical policies.

Each metric is normalized to allow comparability across funds. Control variables such as fund size, sector, geographical location, and strategy are included to isolate the ESG impact.

3.6 Justifying Methodological Choices

The choice of quantile regression and OLS regression is central to this classification. Quantile regression offers unique advantages for analyzing heterogeneity in ESG compliance across funds. Unlike OLS, which estimates the average effect of explanatory variables on a dependent variable, quantile regression provides insights into the distributional characteristics of the data. This approach is particularly relevant when analyzing ESG metrics, which may have differential impacts at various levels of fund performance.

et al. (2023) demonstrated the efficacy of quantile regression in analyzing heterogeneous financial data. Their findings underscore the importance of examining fund-level variations in ESG performance, which may not be evident through pooled OLS analysis. Additionally, quantile regression is robust to outliers, making it suitable for datasets with wide variations in ESG scores or financial returns.

OLS regression is employed for comparative purposes. The analysis clarifies whether it is conducted individually for each fund or in a pooled framework. Individual regressions ensure that fund-specific dynamics are captured, whereas pooled regressions provide an overview of average effects. The choice between these approaches depends on the research objectives and the structure of the data.

3.7 Application of Quantile Regression

Quantile regression is applied separately to each fund to capture the variability in ESG compliance across different performance levels. This method estimates the conditional quantiles of ESG scores, such as the 25th, 50th, and 75th percentiles, offering a comprehensive view of fund performance. For example, a fund performing well in the 75th percentile may exhibit higher environmental compliance compared to those in lower percentiles.

Separate quantile regressions for each fund allow for fund-specific insights, addressing the limitations of pooled analyses. The results reveal significant differences in ESG compliance across funds, highlighting the need for granular analysis. For instance, funds in sectors with high environmental impact, such as energy, may display more pronounced variations compared to those in low-impact sectors like technology.

3.8 Implementation of OLS Regression

OLS regression is utilized to complement the quantile analysis, with two primary approaches:

1. **Individual OLS Regression for Each Fund**: This approach models the relationship between ESG metrics and financial returns for each fund separately. By isolating fund-specific factors, it identifies unique drivers of ESG compliance.
2. **Pooled OLS Regression**: Here, all funds are analyzed together, estimating the average effect of ESG metrics across the dataset. While this approach provides a broader perspective, it may mask fund-specific nuances.

The choice of OLS framework is guided by the study's objectives. For instance, pooled regressions are suitable for assessing industry-wide trends, whereas individual regressions are better for identifying specific characteristics of green funds.

3.9 Control Variables and Sensitivity Analysis

Both quantile and OLS regressions include control variables to account for confounding factors. These variables, such as fund size, sector, and geographical location, ensure that the observed ESG effects are not influenced by extraneous factors. Sensitivity analyses are conducted to test the robustness of results under different scenarios, including alternative

definitions of green funds and varying weighting schemes for ESG metrics.

3.10 Machine Learning for Validation

To validate the regression-based classifications, machine learning algorithms such as Random Forest and Support Vector Machines are employed. These models predict ESG compliance based on fund characteristics, providing a secondary layer of validation. Machine learning also captures non-linear relationships between ESG metrics and fund performance, which may not be detected through regression analyses.

3.11 Qualitative Assessments

In addition to quantitative techniques, qualitative assessments are conducted to evaluate fund disclosures, stakeholder reports, and audit findings. These assessments complement the statistical analyses, ensuring a holistic evaluation of ESG compliance. For example, a fund with strong quantitative ESG metrics may fail to provide transparent disclosures, raising concerns about its green classification.

3.12 Results Interpretation and Benchmarking

The results are benchmarked against established standards such as the EU Taxonomy for Sustainable Activities. This benchmarking ensures that the classifications align with internationally recognized criteria, enhancing their relevance for investors and regulators. The EU Taxonomy defines environmental sustainability criteria, making it a vital reference for classifying funds as green.

4 Econometric model and presentation of results

4.1 OLS regression model

We start with an Ordinary Least Squares (OLS) regression model to establish the relationship between the dependent variable (fund returns) and the other variables (COVID deaths, VIX, US jobless claims, oil prices, and MSCI World Index). It is a first step in the observation of the overall effect of these variables on fund performance.

The relationship is:

$$\text{FUND\_RETURN}_{it} = \alpha + \beta_1 \text{COVID\_DEATHS}_{it} + \beta_2 \text{VIX}_{it} + \beta_3 \text{JOBLESS\_CLAIMS}_{it} + \beta_4 \text{WTI}_{it} + \beta_5 \text{MSCI\_WORLD}_{it} + \epsilon_{it}$$

Where α is the intercept, and β_1, β_2, β_3, β_4, β_5 represent the coefficients of the respective independent variables, and ϵ is the error term.

The indices **i** and t refer respectively to the different funds (i = 1, 2, 3, 4, 5, 6) and to the different time periods (weeks from January 2018 to December 2022)

Panel data model

The dataset consists of multiple funds over a period of time; hence the usefulness of a panel data model, which allows us to take into consideration both cross-sectional (fund-specific) and time-series variations. As we developed in the literature review, it takes into account the heterogeneity across the different funds and examining how they respond to external shocks over time. A fixed-effects or random-effects model will be chosen based on the results of the Hausman test.

$$\text{Fund Return}_{it} = \alpha_i + \beta_1 \text{COVID Deaths}_t + \beta_2 \text{VIX}_t + \beta_3 \text{WTI}_t + \beta_4 \text{Jobless Claims}_t + \beta_5 \text{MSCI World Index}_t + u_{it}$$

The general form of the model is:

Where αi represents the fund-specific fixed effect, and uit is the error term. In the panel data methodology, we can apply two different models:

4.2 Fixed Effects model

The Fixed Effects model (FE) assumes that the differences between individual funds are constant over time and can be captured by fund-specific intercepts. This approach allows us to control for time-invariant characteristics of each fund that may affect their returns (such as the fund's management strategy, geographical focus, or asset structure), but remain unchanged over the study period.

The fixed effects model is represented as follow:

$$\text{Fund Return}_{it} = \alpha_i + \beta_1 \text{COVID Deaths}_t + \beta_2 \text{VIX}_t + \beta_3 \text{WTI}_t + \beta_4 \text{Jobless Claims}_t + \beta_5 \text{MSCI World Index}_t + u_{it}$$

With:

αi the fixed effect for each individual fund iii, capturing time-invariant characteristics (such as a fund's investment strategy or geographical focus).

uit the error term, representing unobserved factors that vary over time for each fund.

The fixed effects model eliminates any bias due to omitted variables that are constant over time, such as the management style or location of the fund. This is especially useful when we are focused on the idiosyncratic fund variation (i.e., how each fund's return changes over time in response to external shocks, in our case the COVID-19 pandemic).

4.3 Random Effects model

The main assumption of the Random Effects model (RE) model is that the differences between funds are random and uncorrelated with the explanatory variables. Thus, it captures both the idiosyncratic variation over time and the variations between funds.

The random effects model is as follow

$$\text{Fund Return}_{it} = \alpha + \beta_1 \text{COVID Deaths}_t + \beta_2 \text{VIX}_t + \beta_3 \text{WTI}_t + \beta_4 \text{Jobless Claims}_t + \beta_5 \text{MSCI World Index}_t + u_{it}$$

In this model:

αit : Represents the overall intercept, common to all funds, while the individual fund effects are captured by the error term.

uit = αi + ϵit : The error term in this model includes a random component αi representing individual fund effects and a random error ϵit

The RE model is in general more suitable when the assumption that fund-specific effects are uncorrelated with the variables is true. However, if these effects are correlated with the explanatory variables, the RE model can conduct to biased results.

Consequently, to decide between the FE and RE model we realize a **Hausman Test**: if the test finds out that the fund-specific effects are correlated with the variables, the FE model is more appropriate. In the opposite case, the RE is more suitable.

4.4 Lagged effects analysis

In addition to the standard model, lagged versions of COVID deaths and jobless claims will be included in the model to capture delayed responses of green funds to the economic and health crises. This is crucial in understanding whether the impact of external shocks, such as a surge in pandemic deaths or unemployment claims, affects fund returns after a certain time lag.

$$\text{Fund Return}_{it} = \alpha_i + \beta_1 \text{COVID Deaths}_t + \beta_2 \text{COVID Deaths}_{t-1} + \beta_3 \text{Jobless Claims}_t + \beta_4 \text{Jobless Claims}_{t-1} + \beta_5 \text{VIX}_t + \beta_6 \text{WTI}_t + \beta_7 \text{MSCI World Index}_t + u_{it}$$

Here:

COVID Deathst−1 : The lagged version of COVID deaths, i.e. the number of COVID-19 deaths from the previous week, t−1

Jobless Claimst−1: The lagged version of the US Jobless Claims, i.e. from the previous week, t-1
Lagged COVID Deaths (β2): The coefficient measures if the number of COVID-19 deaths from the previous week has a delayed effect on the fund's returns. A significant value would suggest that the market reacts with a delay to the impact of the pandemic.

Lagged Jobless Claims (β4): Captures whether the initial jobless claims from the prior week influence fund returns with a delay. A significant value would suggest that the labor market disruptions affect fund performance with a lag.

Implementing both current and lagged variables enables a comprehensive understanding of how external factors like COVID deaths and the US jobless claims affect fund returns. Some of them could have **both immediate and lasting effects** on fund performance

4.5 Quantile regression model

Quantile regression assesses the influence of independent variables on various points within the distribution of the dependent variable. This focuses on the response of different segments of the data instead of the average effects of the explanatory variables. In fund performance assessment and analysis, it is powerful, as fund returns are often characterized by a significant variability in reaction to economic conditions.

The model specification is:

$$Q_{FUND\_RETURN}(\tau|X) = \beta_0(\tau) + \beta_1(\tau)COVID\_DEATHS + \beta_2(\tau)VIX + \beta_3(\tau)WTI + \beta_4(\tau)JOBLESS\_CLAIMS + \beta_5(\tau)MSCI\_WORLD$$

With:

QFUND_RETURN(τ|X) denotes the conditional quantile of the fund returns at a specific quantile τ, given the variables X

Each coefficient βj(τ) corresponds to its respective quantile, which emphasizes the fact that the impact of the variables can vary along the fund return distribution

The Quantile Regression has three advantages in our case:

Exhibiting resilience to outliers, which is not the case for a standard OLS which usually exhibits a skewness caused by extreme values. This disadvantage is mitigated by the quantile regression as it takes into consideration quantiles instead of being mean-focused

Revealing the varied impacts of variables across the distribution of fund returns

Analyzing across the entire range of the fund performances

5 Empirical results

5.1 Presentation of the tests

Table 2: Descriptive statistics of the variables used

Statistic	Pimco Total Return	Allianz Global Sust.	Calvert US	TIAA-CREF	Mirova Euro Sustainable	UBS Euro Sust.	MSCI World
Mean Return	0.12%	0.10%	0.16%	0.18%	0.14%	0.14%	0.27%
Standard Deviation	0.0322	0.0316	0.0354	0.0349	0.0351	0.0368	0.0306
Minimum	-4.41%	-15.47%	-14.40%	-15.26%	-22.98%	-22.98%	-12.50%
25th Percentile	-0.34%	-0.99%	-0.91%	-0.96%	-1.61%	-1.61%	-1.33%
Median	0.00%	0.24%	0.30%	0.31%	0.43%	0.43%	0.30%
75th Percentile	0.34%	1.12%	1.19%	1.20%	1.56%	1.56%	1.60%
Maximum	3.54%	13.91%	10.25%	10.81%	13.22%	13.22%	11.00%
Maximum Drawdown	-4.41%	-19.54%	-19.63%	-19.32%	-22.98%	-22.98%	-12.50%
Kurtosis	3.68	10.86	8.56	8.22	9.25	9.25	6.55
Skewness	-1.36	-1.95	-1.85	-1.92	-1.77	-1.77	-1.55

TIAA-CREF shows the highest mean return (0.29%), suggesting it generally performs better over time compared to the others. **PIMCO Total Return** has the lowest mean return (0.12%).

PIMCO Total Return has the lowest volatility (0.0118), indicating it is the least risky of the group, while **UBS Euro Sustainable** has the highest volatility (0.0423), implying a higher risk level. The maximum drawdown reflects the largest percentage drop from a fund's peak to its lowest point.

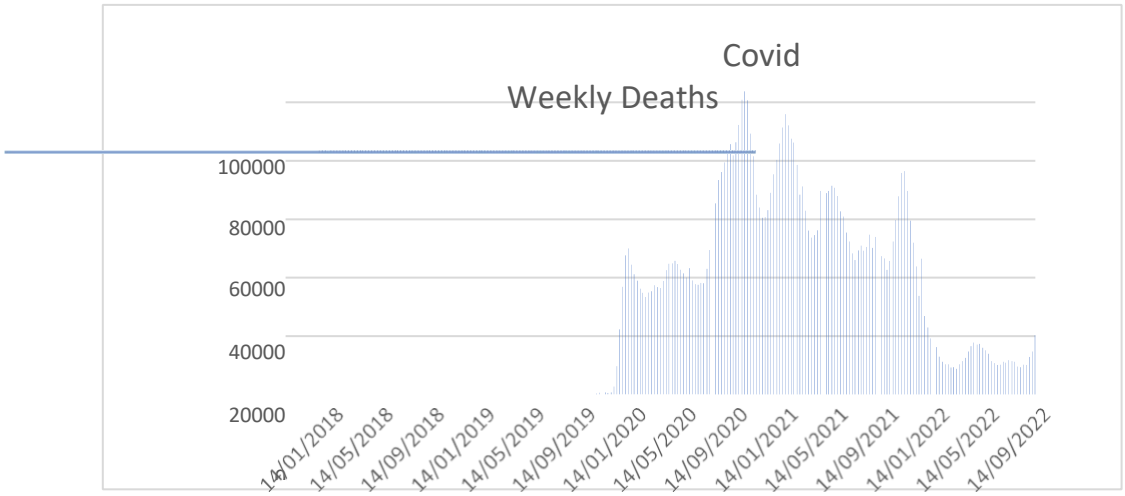
All funds experience significant drawdowns, given the tumultuous period caused by the pandemic with Mirova Euro and UBS Euro Sustainable showing the highest drawdowns (-22.98%), while the global-oriented funds are slightly more resilient. All funds show negative skewness, meaning their distributions have long tails on the left side, implying a higher probability of extreme negative returns.

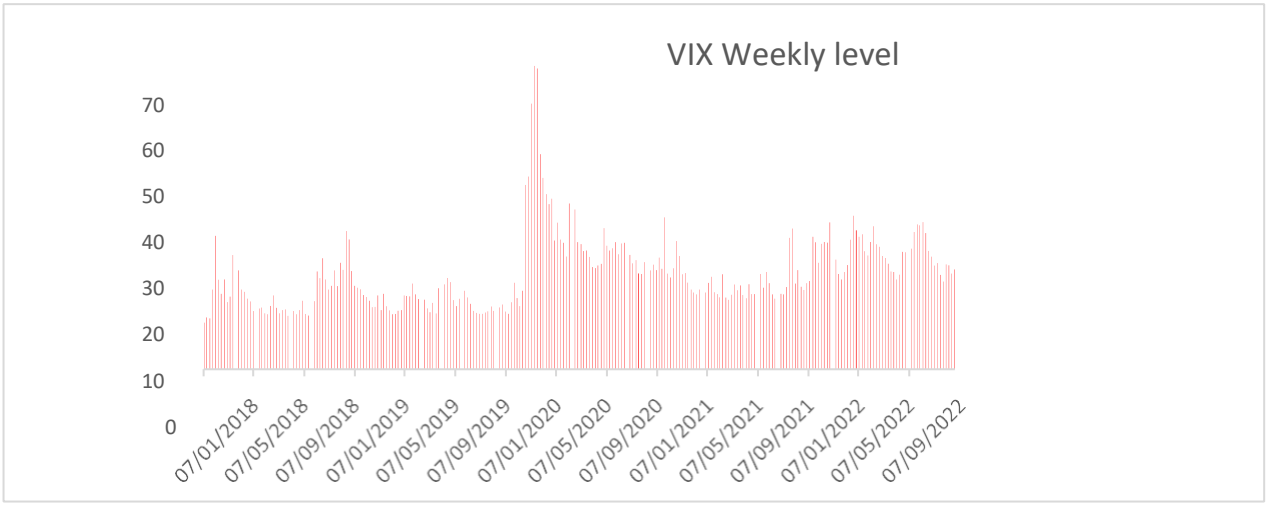
There is little variation in skewness across the funds, indicating they all have similarly skewed return distributions. All funds have high kurtosis values, indicating heavy tails, which suggests a higher likelihood of extreme returns (both positive and negative). There is little distinction between the funds in this regard. The MSCI World index has a mean return of 0.27%, placing it on par with the best-performing funds, while it has a standard deviation of 0.0306, slightly higher than some funds but lower than others. Its volatility is moderate compared to the riskier funds.

The maximum drawdown of -12.5% indicates a significant decline during market downturns but is less severe than the maximum drawdowns observed in some of the funds (which exceed 20%). The kurtosis is 6.55, the MSCI World index has a distribution with moderately fat tails, meaning it is prone to larger returns, both positive and negative but has lower kurtosis than the funds, being less prone to extreme events. It exhibits a negative skewness of -1.55, meaning the left tail (potential losses) is heavier, which implies more downside risk.

❖ **The Covid weekly deaths and the weekly VIX level**

Figure 6: Weekly Evolution of COVID-19 Deaths and the Weekly Level of the Volatility Index (VIX)





OLS initial Regression Results:

We have conducted the initial OLS regression and the others using EViews:

Table 3: Regression results

Variables	**C**	**COVID_DEATHS**	**VIX**	**WTI**	**MSCI_WORLD**	**JOBLESS_CLAIMS**
Coefficient	−0,001	6,30E−09	0,001	−0,016	0,031	0,000
T-Statistic	−1,423	0,236	0,348	−1,675	1,019	1,869
Prob	0,156	0,81	0,728	0,096	0,309	0,063
R^2= 0,052155			F-statistic= 1,650759		Prob= 0,150043	
Durbin-Waston stat= 1,935836						

Source: Authors (2024)

Based on the PIMCO regression above, a fund-by-fund OLS regression delivers as expected a poor R^2 = 0.05215. The other funds display the same level of low significancy of the model. We will move to the panel regression.

Panel Data Analysis:

The panel analysis is conducted as follow:

Table 4: Regression results of panel data

Variables	C	**COVID_DEATHS**	**VIX**	**WTI**	**JOBLESS_CLAIMS**	**MSCI_WORLD**
Coefficient	0,000	−1,22E−08	0,005	−0,002	−8,94E−05	0,780
T-Statistic	0,622	−0,876	1,711	−0,352	−0,516	35,902
Prob	0,533	0,381	0,087	0,724	0,605	0,000
R^2=0,614665			F-statistic= 493,8573		Prob=0,000	
Durbin-Waston= 2,331667						

Source: Authors (2024)

5.2 Interpreting the results

According to our results, the coefficient for the intercept is 0.0003480, but it is not statistically significant (p-value = 0.5336). This means that the baseline returns of the funds, when all other variables are zero, is not significantly different from zero. As for the Covid_deaths the coefficient is negative (-1.22×10^{-8}) suggesting that an increase in COVID-19 deaths slightly reduces the fund returns. However, it is not statistically significant (p-value = 0.3811), indicating that the relationship between COVID-19 deaths and fund returns is not strong enough to draw a firm conclusion. The coefficient of VIX is positive (0.005493), implying that an increase in market volatility (higher VIX) is associated with higher fund returns.

The p-value is 0.0872, suggesting marginal significance at the 10% level (often considered weak evidence of a relationship). With regard to the coefficient WTI is negative (−0.002374), indicating that an increase in oil prices reduces the fund returns, but it is not statistically significant (p-value = 0.7246). The coefficient of US Jobless_claims is negative (-8.94×10^{-5}), suggesting that an increase in jobless claims leads to a slight reduction in fund returns. However, this relationship is not statistically significant (p-value = 0.6056). The coefficient of MSCI_WORLD is positive

(0.780976), and this variable is highly statistically significant (p-value = 0.0000). This indicates a strong positive relationship between the performance of the global stock market (as measured by the MSCI World Index) and the fund returns. For each unit increase in the MSCI World Index, the fund returns increase by approximately 0.78 units. This is the most impactful variable in the model.

5.2.1 Goodness-of-Fit

The R-squared value is 0.6147, meaning that approximately 61.47% of the variation in fund returns is explained by the independent variables in the model. This is a decent fit, indicating that the model explains a good portion of the variability in the fund returns.

The adjusted R-squared is 0.6134, which accounts for the number of predictors in the model. The adjusted value is only slightly lower than the R-squared, which suggests that the included variables are fairly relevant to explaining fund returns.

5.2.2 Overall Model Significance (F-statistic)

The F-statistic is 493.8573, with a p-value of 0.0000, indicating that the overall model is statistically significant, the independent variables as a group are significantly related to the dependent variable.

5.2.3 Autocorrelation

The value of the Durbin-Watson stat is 2.331667, which is close to 2. This suggests that there is likely no serious autocorrelation issue in the residuals, which is a good sign for the reliability of the results.

5.2.4 Interpretation of Key Findings

The MSCI World Index is the strongest and most statistically significant predictor of fund returns. This indicates that global stock market performance has a substantial impact on the performance of green investment funds. The market volatility has a marginally significant positive effect on fund returns, suggesting that green funds might perform well during periods of market uncertainty. The variables COVID deaths, WTI, and jobless claims do not have a statistically significant effect on fund returns in this model. This could mean that either the impact of these variables is limited, or more refined or lagged versions of these variables may provide clearer relationships.

Discuss any significant differences between funds, potentially using fixed effects or random effects models.

5.2.5 Interpretation of the heteroscedasticity test:

Null Hypothesis: Residuals are homoscedastic (i.e., the variance of the errors is constant across cross-sections).
Alternative Hypothesis: Residuals are heteroskedastic (i.e., the variance of the errors is not constant across cross-sections).

Key Values:

Likelihood Ratio (LR) Statistic: 1266,338
Degrees of Freedom (df): 6
Probability (p-value): 0.0000

Since the p-value is 0.0000, which is far less than the standard significance level of 0.05, so we reject the null hypothesis. This indicates that heteroskedasticity is present in our panel data, meaning that the variance of the residuals differs across the funds. (See appendices)

Then, let us correct for heteroskedasticity by conducting a lagged effect analysis with the quantile regression methodology to have more refined results.

Lagged Effects Analysis with quantile regression

Analysis of the quantile with tau = 0.1

5.2.6 Examine the coefficients of the lagged variables

Table 5: Quantile Regression Results (tau = 0.1)

Variables	**C**	**I_COVID_DEATHS**	**VIX**	**WTI**	**I_JOBLESS_CLAIMS**	**MSCI_WORLD**
Coefficient	−0,018	5,39E−08	−0,006	0,018	−7,28E−05	0,665
T-Statistic	−16,645	1,902	−0,817	1,818	−0,261	18,826
Prob	0,000	0,057	0,413	0,069	0,793	0,000
R^2=0,400		Quantile dependent var= −0,024			Prob= 0,000	
Quasi-LR statistic= 747, 4781						

Source: Authors (2024)

Coefficients and significancy of coefficients of the lagged variables:

L_COVID_DEATHS (Lagged COVID-19 Deaths):

Coefficient: 5.39E-08 **Std. Error**: 2.83E-08 **t-Statistic**: 1.902367

Probability: 0.0573 (marginal significance)

Thus, although marginally significant, an increase in lagged COVID-19 deaths has a very small positive effect on the 10th percentile of fund returns. We notice that the p-value has decreased significantly with this method

L_JOBLESS_CLAIMS (Lagged Jobless Claims):

Coefficient: -7.28E-05 **Std. Error**: 0.000278 **t-Statistic**: -0.261907

Probability: 0.7934 (not significant)

Thus, even lagged, jobless claims do not have a statistically significant impact on the 10th percentile of fund returns.

Let us consider the model fit:

Pseudo R-squared: 0.4003. Approximately 40% of the variability in the 10th quantile of fund returns is explained by the model.

Adjusted R-squared: 0.3984**.** Adjusted for the number of predictors, the model still explains approximately 39.84% of the variation in the fund return.

Quasi-LR statistic: 747.4781 and **Probability (Quasi-LR stat)**: 0.000000. Thus, we can assert that the model is statistically significant overall.

Overall, the MSCI World Index is the most significant predictor with a positive coefficient, indicating that global stock market movements are crucial in explaining returns at the lower quantile. Lagged COVID deaths and WTI oil prices have marginally significant effects, suggesting some influence on returns at this quantile.

Now let us move the important part, which is the analysis of the evolution across the different quantiles to analyze how the relationships between the independent variables and fund returns evolve across different parts of the distribution.

5.2.7 Quantile Regression:

Evolution from Tau = 0.1 to Tau = 0.9 (see in Appendix the Eviews regression results for the other quantiles).

Intercept (C): The intercept shows a steady increase from negative values at lower quantiles (-0.018476 at tau= 0.1) to increasingly positive values at higher quantiles (0.018100 at tau = 0.9). The base level of fund returns (not explained by the included independent variables) grows as we

move towards higher-performing funds.

Lower-performing funds have negative base returns, while higher-performing funds have increasingly positive base returns.

L_COVID_DEATHS: The significance of lagged covid deaths varies across quantiles. It's insignificant at some quantiles but becomes significant at higher quantiles.
At tau = 0.1: Positive coefficient (5.39E-08) and marginal significance (p = 0.0573).
At tau = 0.9: The coefficient becomes more negative (-5.73E-08) and significant (p = 0.0095)

The impact of lagged COVID-related deaths shifts from being mildly positive at lower quantiles to significantly negative at higher quantiles. Lagged COVID-19 deaths may have had a negative impact on higher-performing funds, possibly reflecting greater exposure to sectors that are sensitive to the pandemic, and the effect on lower-performing funds was relatively neutral.

VIX

The significance of the VIX grows steadily as we move from tau = 0.1 to tau = 0.9. At tau = 0.1: Insignificant with a small negative coefficient (-0.006753, p = 0.4135). At tau = 0.9: Significant with a positive coefficient (0.018304, p = 0.0179). The impact of VIX becomes more pronounced at higher quantiles, indicating that market volatility has a larger effect on high-performing funds. Higher-performing funds are more sensitive to market volatility, while lower-performing funds may be less exposed to market fluctuations.

WTI (West Texas Intermediate Oil Price)

The significance of WTI fluctuates across quantiles, but its coefficient generally remains negative, especially at higher quantiles.
At tau = 0.1: Positive but insignifiant (p = 0.0692).

At tau = 0.9: Negative and nearly significant (p = 0.0635).

The effect of WTI starts as positive at lower quantiles and turns negative at higher quantiles. Rising oil prices may have a positive effect on lower-performing funds, which are the most exposed to utilities and energy sectors, but they negatively impact higher-performing funds.

L_JOBLESS_CLAIMS

The variable remains largely insignificant across all quantiles, with no strong pattern emerging. Jobless claims do not seem to play a major role in explaining fund returns across different performance levels.

MSCI_WORLD

As expected, the MSCI World Index is highly significant at all quantiles, with consistently strong positive coefficients. At tau = 0.1: Coefficient of 0.665143 (p = 0.0000). At tau = 0.9: Coefficient of 0.800015 (p = 0.0000).

The influence of the MSCI World Index on fund returns strengthens as we move to higher quantiles. Global equity markets are a driver of fund returns, and their influence is stronger for higher-performing funds. Considering the results above, higher-performing funds demonstrate greater sensitivity to global factors such as the MSCI World Index and VIX, with volatility and global market returns exerting a stronger influence on upper quantiles. This suggests that these funds are more exposed to systemic market risks or reliant on global market trends.

The effect of lagged COVID-19 deaths shifts from neutral or mildly positive at lower quantiles to significantly negative at higher quantiles, indicating that top-performing funds likely faced greater risks during the pandemic, potentially due to their exposure to affected sectors or regions.

Oil prices, particularly WTI, show a more negative impact at higher quantiles, implying that rising oil prices adversely affect top-performing funds, while lower-performing ones may benefit, possibly due to energy sector exposure. Jobless claims, however, do not significantly explain fund returns across any quantiles, suggesting that labor market conditions might not directly influence

these funds.

Lastly, the MSCI World Index has a strong and positive impact across all quantiles, with a more pronounced effect at higher levels, highlighting the stronger link between top-performing funds and global market performance

5.3 Policy Implications for Green Investment Funds

The negative impact of COVID-19 on higher-performing green investment funds reveals the need for stronger risk management strategies to mitigate pandemic-related shocks. Policies should encourage funds to integrate pandemic preparedness into their risk models, diversify their portfolios to minimize exposure to vulnerable sectors, and adopt stress-testing methods to enhance resilience against future global health or environmental disruptions. Furthermore, policy measures could promote investment in sectors that demonstrated resilience during the pandemic, such as renewable energy, sustainable infrastructure, and healthcare. By aligning investments with long-term sustainability goals, funds can bolster both environmental impact and financial stability.

Governments can incentivize green investments during crises by offering instruments like government-backed green bonds or tax incentives that encourage capital flow into sustainable funds, even in times of market instability. Subsidies for green companies that maintain environmental impact while navigating disruptions would also support long-term resilience. Additionally, enhancing investor education on sustainable finance is vital to fostering confidence in green assets as a protective strategy against future environmental crises. Transparent ESG reporting from funds can reinforce trust and align financial returns with sustainability.

The pandemic underscored the interconnectedness of public health and sustainability, signaling the need for an integrated approach in policy frameworks. Public health risks should be part of the broader sustainability agenda, encouraging investment in innovations that enhance both climate resilience and public health outcomes. In conclusion, quantile regression analysis shows that COVID-19's impact on green investment funds differs across performance levels, emphasizing the importance of robust risk management, resilience, and sectoral diversification. Policymakers must provide support to encourage sustainable investments during crises, fostering a green and stable global economy.

The study's quantile regression analysis suggests that green funds don't necessarily provide a safer investment option during crises. Despite their focus on sustainability and environmental impact, green funds show a similar level of vulnerability to market disruptions, such as the COVID-19 pandemic, compared to traditional funds. Notably, higher-performing green funds are more responsive to global factors like the MSCI World Index and volatility, revealing their exposure to broader systemic risks.

In lower quantiles, the impact of COVID-19 deaths was either neutral or slightly positive, but as we move to higher quantiles, this effect turns significantly negative. This indicates that top-performing green funds faced greater challenges during the pandemic, potentially due to their involvement in more affected sectors or regions. Rising oil prices also negatively impacted these higher-performing funds, possibly highlighting their sensitivity to changes in energy markets.

Ultimately, while green funds provide long-term value through sustainability, their performance during crises mirrors that of other funds, showing similar susceptibility to market conditions and sectoral risks. This reinforces the importance of robust risk management and diversification to strengthen their resilience in times of economic or market turbulence.

6 CONCLUSION

This study adds to the existing literature on green funds by examining their behavior during periods of financial stress, particularly looking at their performance across different levels during the COVID-19 pandemic. It applies quantile regression to explore how green funds react to market shocks depending on their performance tier, offering a more detailed view of their vulnerabilities. Unlike other studies that focus on average fund performance, this analysis suggests that the sensitivity of green funds to global market factors like the MSCI World Index and volatility may be more pronounced in higher-performing funds.

The study also looks at the impact of pandemic-specific factors, such as COVID-19 deaths, finding that while lower-performing funds were less affected, higher-performing funds experienced more negative effects. This adds to the understanding of how green funds face different levels of risk during crises, an aspect that has been less explored in previous research that focuses on ESG performance in more stable periods.

On another level, our work aligns and complements the work of Agoraki et al. in "How has COVID-19 affected the performance of green investment funds?" by similarly focusing on the pandemic's impact on green funds. Both studies shed light on the vulnerabilities faced by green funds during the COVID-19 crisis, despite their alignment with sustainable and socially responsible goals. Agoraki et al. found mixed resilience among green funds: some outperformed traditional funds during the pandemic, while others exhibited vulnerabilities to market shocks.

Our study builds on this by offering a more granular perspective, using quantile regression to assess how market factors like the MSCI World Index and volatility (VIX) affect green fund performance across different tiers. While Agoraki et al. focused on overall fund performance, this study adds elements by revealing that higher-performing green funds are more sensitive to systemic risks. This vulnerability, explain why these funds experienced significant negative impacts from COVID-19 deaths. This finding complements Agoraki et al.'s conclusion about the

mixed resilience of green funds adds nuance by showing which funds, especially those with higher returns—were more exposed. The study does not challenge the work of Agoraki et al., but tries to fill a gap by providing insights into how pandemic-related shocks affected green funds differently across the performance spectrum.

This follows the path of the broader literature on green finance, by considering paramount targeted risk management and diversification, especially for higher- performing funds aiming for long-term sustainability, top ESG scoring, and resilience during crises. However, our study but it faces certain limitations that suggest further research. A major challenge was the restricted access to comprehensive fund performance data. This limited the size of our sample, which may affect the applicability of our conclusions to a broader set of green funds.

Additionally, using the student version of EViews 12 placed further restrictions on the number of observations and variables we could analyze, narrowing the scope of our study and potentially limiting a more detailed understanding of fund behavior across a larger and more diverse dataset. Addressing these data and software constraints in future research could allow for stronger statistical analyzes and provide more comprehensive insights into the factors driving green fund performance.

Moreover, while our use of quantile regression allowed us to examine the sensitivity of green funds to market factors, the study does not capture the full complexity of fund performance in times of crisis. For instance, we did not fully explore the dynamic, time-varying relationships or specific sector shocks that might have played a crucial role during the pandemic. Future research could employ more advanced econometric techniques, such as panel data analysis or time-varying models, to investigate how these relationships evolve over time.

Another interesting avenue for further study could involve looking at investor sentiment or behavioral influences, which may have a significant impact on green fund returns but were not explored in our analysis. An important limitation of ESG funds, even those with strong

sustainability ratings, lies in their unavoidable exposure to large corporations. Despite meeting ESG criteria, these corporations are often deeply embedded in global markets, and some may engage in practices that don't fully align with the core values of sustainable investing.

This challenge stems from the need for ESG funds to balance their ethical commitments with the financial obligation to deliver competitive returns. Large corporations provide the market liquidity and financial stability required to meet shareholder and fund holder expectations. As a result, fund managers often feel compelled to include these companies in their portfolios, despite the potential for conflicts with sustainability goals.

The pressure to maintain short-term financial performance adds further complexity, as it can lead fund managers to prioritize returns over long-term environmental or social objectives. This reliance on large companies may also expose ESG funds to risks related to governance or environmental issues, which can complicate their overall mission. This dynamic highlights the difficulty of fully aligning ESG objectives with the financial realities of green investment funds.

In terms of future research directions, it would be valuable to explore how green funds react to different types of crises beyond pandemics, such as geopolitical events or climate-related disasters, to assess whether these funds offer any specific advantages in terms of resilience. A potential follow-up study could also examine the role of firm-level ESG practices in strengthening fund performance during crises. This approach would allow researchers to determine whether funds that invest in companies with stronger ESG profiles are better prepared to weather economic downturns, thereby contributing to a deeper understanding of the relationship between sustainable investing and risk management.

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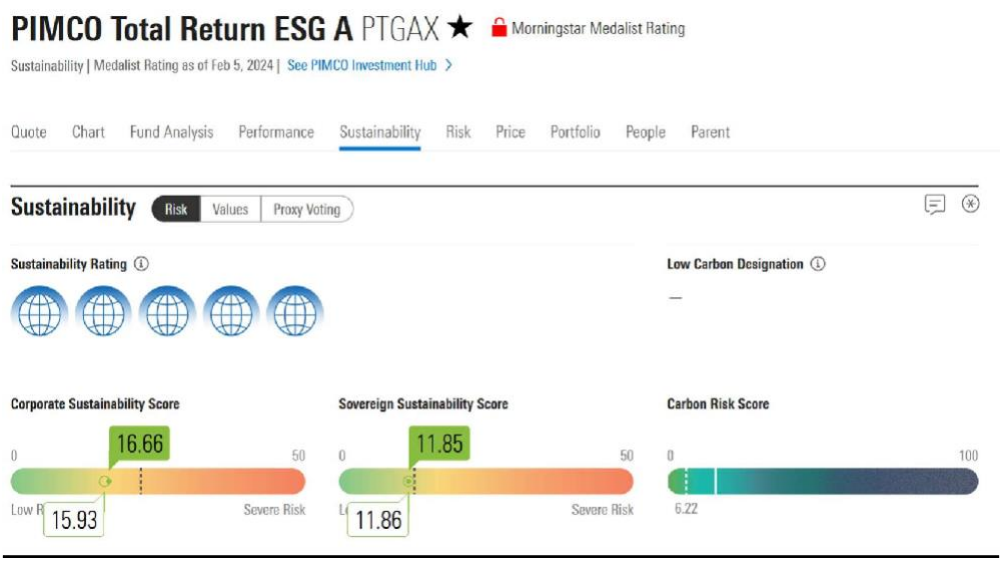
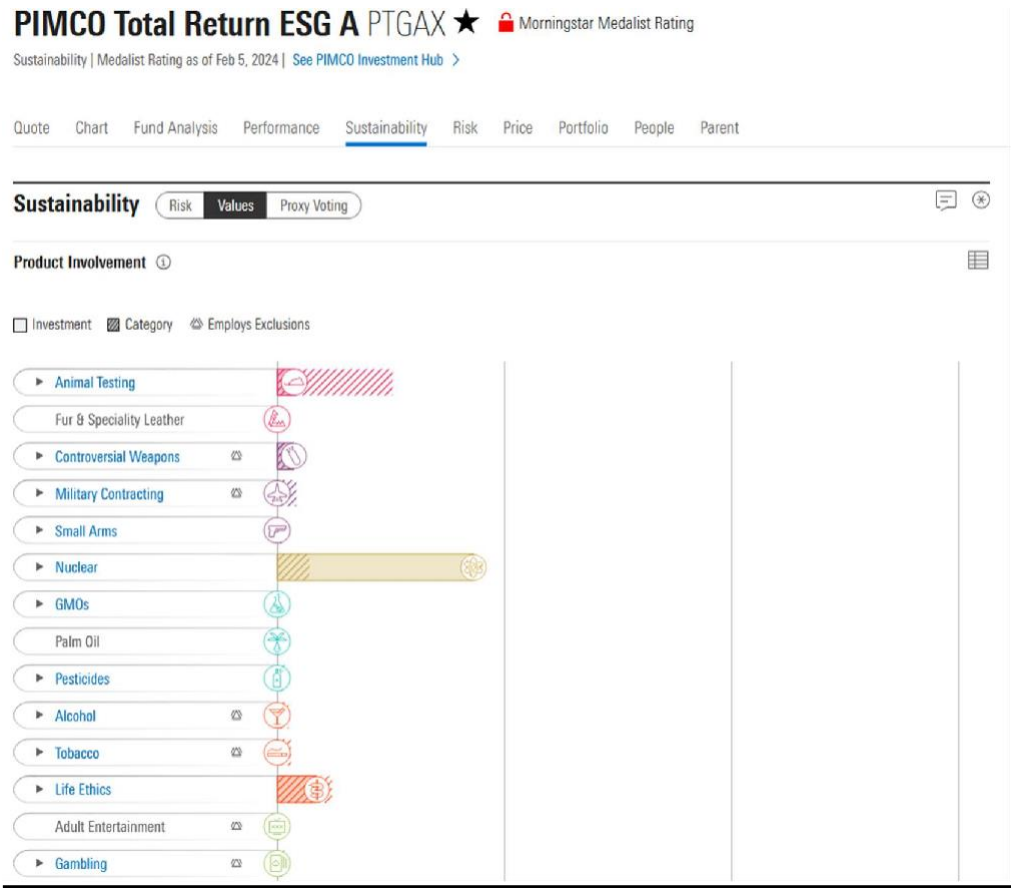
8 APPENDIX

Funds Morningstar factsheets





PIMCO Total Return ESG A PTGAX ★ Morningstar Medalist Rating

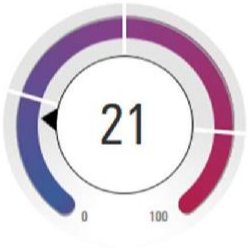
Risk | Medalist Rating as of Feb 5, 2024 | See PIMCO Investment Hub >

Quote | Chart | Fund Analysis | Performance | Sustainability | Risk | Price | Portfolio | People | Parent

Risk

3-Yr | 5-Yr | 10-Yr

Portfolio Risk Score



Risk Score	Risk Level
0–23	Conservative
24–47	Moderate
48–78	Aggressive
79–99	Very Aggressive
100+	Extreme

Morningstar Risk & Return

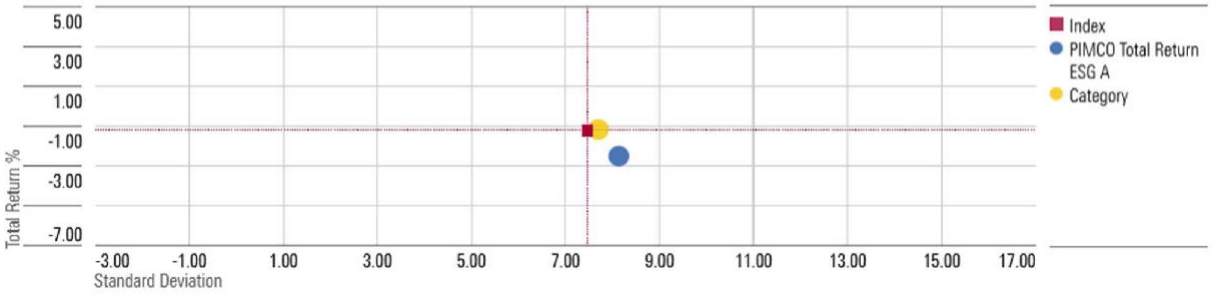
Risk vs. Category

Return vs. Category

Risk & Volatility Measures

Capture Ratios	Investment	Category	Index
Alpha	-0.85	0.18	—
Beta	1.05	0.99	—
R^2	97.52	95.86	—
Sharpe Ratio	-0.76	-0.62	-0.65
Standard Deviation	8.13	7.70	7.47

Risk/Return Analysis



Exposure

vs. Category % ∨

Sectors	Investment %	Cat %
Government	25.59	26.57
Municipal	0.23	0.61
Corporate	17.93	26.52
Securitized	35.44	38.99
Cash & Equivalents	12.38	6.45
Derivative	8.43	0.87

Investment as of Jun 30, 2024 | Category: Intermediate Core-Plus Bond as of Aug 31, 2024 | Sector data is based on the rescaled long position of the holdings. | Source: Holdings-based calculations.

Bond Breakdown

Credit Quality ∨ | vs. Category % ∨

Grades	Investment %	Cat %
AAA	66.35	35.70
AA	7.65	22.35
A	11.45	11.56
BBB	12.80	19.06
BB	1.01	5.02
B	0.01	2.27
Below B	0.73	1.01
Not Rated	0.00	3.03

As of Jun 30, 2024 | Category: Intermediate Core-Plus Bond | Credit Quality Data is based on the long position of the holdings. | Source: Manager-reported.

PIMCO Total Return ESG A PTGAX ★ Morningstar Medalist Rating

Portfolio | Medalist Rating as of Feb 5, 2024 | See PIMCO Investment Hub >

Quote Chart Fund Analysis Performance Sustainability Risk Price Portfolio People Parent

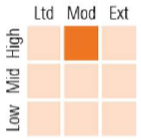
Portfolio

Asset Allocation ⓘ Classic | Economic Exposure | Market Value

Asset Class	Net	Short	Long
Equity	-0.36	-0.72	0.36
Fixed Income	139.90	-25.35	165.25
Other	-0.65	-0.65	0.00
Cash	-37.72	-40.24	2.52
Total	101.17	-66.97	168.14

As of Jun 30, 2024 | Source: Holdings-based calculations.

Fixed Income Style Current | Historical



Fixed Income Measures	Investment	Category Average
Effective Duration	5.87	6.18
Modified Duration	5.87	6.29
Effective Maturity	7.66	9.03
Avg Credit Rating (surveyed)	AA	A+
Weighted Coupon	3.86	4.08
Weighted Price	89.75	91.90
Yield to Maturity	5.81	5.71

Investment as of Jun 30, 2024 | Category: Intermediate Core-Plus Bond as of Aug 31, 2024 | Source: Manager-reported and holdings-based calculations.

% Assets in Top 10 Holdings	Reported Turnover %	Women Directors %	Women Executives %
22	468.00 As of 03/31/24	—	—

Holdings	% Portfolio Weight	Market Value as of Jun 30, 2024	Cur	Share Change %	Maturity Date	Coupon Rate	Sector
Federal National Mortgage Association 3%	7.83	137,867,970	USD	↑ 100.00	Aug 13, 2054	3.00	S
Federal National Mortgage Association 5.5%	5.62	99,011,633	USD	↑ 100.00	Aug 13, 2054	5.50	S
United States Treasury Bonds 3.25%	4.63	81,438,651	USD	0.00	May 15, 2042	3.25	G
IRS EUR 2.75000 09/18/24-10Y LCH Receive	4.41	77,721,640	EUR	↑ 100.00	Sep 18, 2034	—	G
Federal National Mortgage Association 6%	4.29	75,485,308	USD	↑ 100.00	Aug 13, 2054	6.00	S
5 Year Treasury Note Future Sept 24	4.27	75,202,789	USD	↑ 100.00	Oct 01, 2024	—	G
Federal National Mortgage Association 5%	3.26	57,331,655	USD	↑ 100.00	Jul 15, 2054	5.00	S
10 Year Treasury Note Future Sept 24	2.71	47,785,430	USD	↑ 100.00	Sep 20, 2024	—	G
2 Year Treasury Note Future Sept 24	2.30	40,436,086	USD	↑ 100.00	Oct 01, 2024	—	G
RFR USD SOFR/2.68750 04/04/24-1Y LCH Receive	2.09	36,800,205	USD	↑ 100.00	Apr 04, 2025	—	G

Allianz Global Investors Fund - Allianz Global Sustainability A EUR | Register to Unlock Ratings

Allianz Global Investors Fund - Allianz Global Sustainability A EUR | Register to Unlock Ratings

Morningstar Rating™(Relative to Category) 31/08/2024

	Morningstar Return	Morningstar Risk	Morningstar Rating™
3-Year	Average	Low	★★★★
5-Year	Average	Below Average	★★★
10-Year	Average	Average	★★★
Overall	Average	Below Average	★★★

Category : Global Large-Cap Blend Equity

Click here to see our Methodology

1 Year Daily Volatility Chart (annualised)

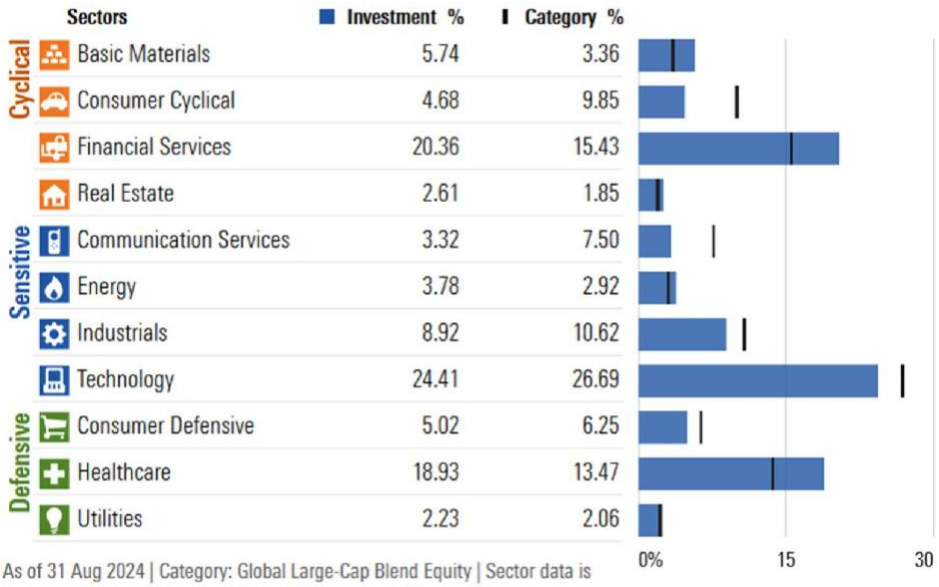
Performance history not available.

Volatility Measurements 30/09/2024

3-Yr Std Dev	10.95 %	3-Yr Sharpe Ratio	0.18
3-Yr Mean Return	5.33 %		

Modern Portfolio Statistics	30/09/2024	30/09/2024
	Standard Index	Best Fit Index
	Morningstar Global TME NR USD	Cat 85%FTSE Wld TR&15%Barclays StlAgg TR
3-Yr Beta	0.93	0.93
3-Yr Alpha	-3.09	-2.49

Exposure Sector | Region | Country | vs. Category % ∨

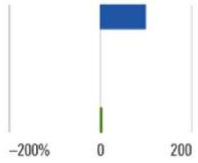


As of 31 Aug 2024 | Category: Global Large-Cap Blend Equity | Sector data is based on the rescaled long position of the holdings. | Source: Holdings-based calculations.

Allianz Global Investors Fund - Allianz Global Sustainability A EUR | Register to Unlock Ratings

Portfolio

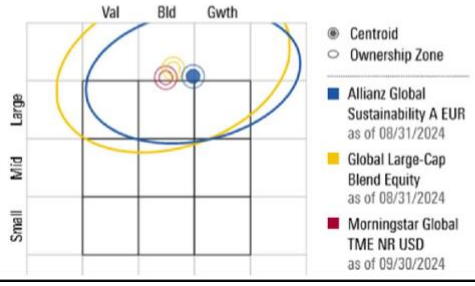
Asset Allocation (Classic | Economic Exposure | Market Value)



Asset Class	Net	Short	Long
Equity	97.78	–	97.78
Fixed Income	–	–	–
Other	–	–	–
Cash	2.22	-0.66	2.88
Total	100.00	-0.66	100.66

As of 31 Aug 2024 | Source: Holdings-based calculations.

Stock Style (Map | Weight | Historical)



Holdings (Equity)

Equity Holdings	Bond Holdings	Other Holdings	% Assets in Top 10 Holdings
44	0	30	33

Reported Turnover %	Active Share	Women Directors %	Women Executives %
—	77.01	38	26

As of —

Holdings	% Portfolio Weight	First Bought	Market Value EUR as of 31 Aug 2024
Microsoft Corp	7.21	31 Oct 2011	165,041,455
Alphabet Inc Class A	3.25	30 Sept 2023	74,329,843
Unilever PLC	3.12	31 Jan 2011	71,395,393
S&P Global Inc	3.07	30 Apr 2016	70,215,101
Medtronic PLC	3.05	30 Apr 2023	69,860,315
Visa Inc Class A	2.74	31 Aug 2011	62,674,589
Zoetis Inc Class A	2.68	30 Apr 2024	61,426,960
London Stock Exchange Group PLC	2.64	30 Sept 2023	60,363,287
DSM Firmenich AG	2.61	31 Dec 2023	59,687,954
Amazon.com Inc	2.58	31 May 2024	59,026,424

Holdings as of 31 Aug 2024 | This investment's holding data is suppressed to show the top 10.

Calvert US Large Cap Core Rspnb Idx I CISIX ★★★★ Morningstar Medalist Rating

Sustainability | Medalist Rating as of Apr 30, 2024 | See Eaton Vance Investment Hub >

Quote Chart Fund Analysis Performance Sustainability Risk Price Portfolio People Parent

Sustainability

Risk | Values | Proxy Voting

Sustainability Rating

Low Carbon Designation

Low Carbon

Corporate Sustainability Score

0 — 20.15 — 50

Low Risk 19.34 Severe Risk

Sovereign Sustainability Score

0 — 50

Low Risk Severe Risk

Carbon Risk Score

0 — 5.12 — 100

7.47

Calvert US Large Cap Core Rspnb Idx I CISIX ★★★★ Morningstar Medalist Rating

Sustainability | Medalist Rating as of Apr 30, 2024 | See Eaton Vance Investment Hub >

Quote Chart Fund Analysis Performance Sustainability Risk Price Portfolio People Parent

Sustainability

Risk | Values | Proxy Voting

Product Involvement

Investment Category Employs Exclusions

- Animal Testing
- Fur & Speciality Leather
- Controversial Weapons
- Military Contracting
- Small Arms
- Nuclear
- GMOs
- Palm Oil
- Pesticides
- Alcohol
- Tobacco
- Life Ethics
- Adult Entertainment
- Gambling

Calvert US Large Cap Core Rspnb Idx I CISIX ★★★★ Morningstar Medalist Rating

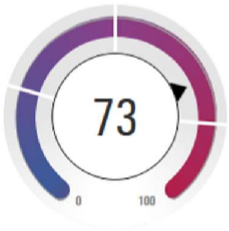
Risk | Medalist Rating as of Apr 30, 2024 | See Eaton Vance Investment Hub >

Quote | Chart | Fund Analysis | Performance | Sustainability | **Risk** | Price | Portfolio | People | Parent

Risk

3-Yr | 5-Yr | 10-Yr

Portfolio Risk Score



Risk Score	Risk Level
0–23	Conservative
24–47	Moderate
48–78	**Aggressive**
79–99	Very Aggr…
100+	Extreme

Morningstar Risk & Return

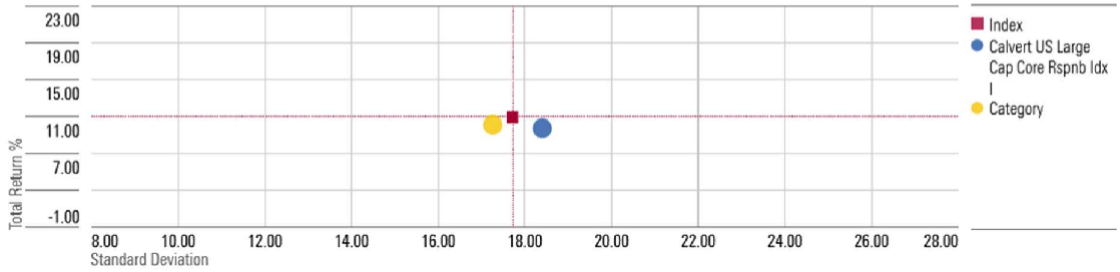
Risk vs. Category

Return vs. Category

Risk & Volatility Measures

Capture Ratios	Investment	Category	Index
Alpha	-2.19	-1.25	-0.92
Beta	1.04	0.95	1.01
R^2	98.91	93.52	99.81
Sharpe Ratio	0.39	0.43	0.46
Standard Deviation	18.40	17.26	17.72

Risk/Return Analysis



Exposure

Sector | Region | Country | vs. Category %

	Sectors	Investment %	Cat %
Cyclical	Basic Materials	2.61	2.59
	Consumer Cyclical	10.79	9.69
	Financial Services	13.53	13.39
	Real Estate	3.14	1.96
Sensitive	Communication Services	6.84	8.44
	Energy	0.46	3.71
	Industrials	8.78	9.78
	Technology	33.61	29.78
Defensive	Consumer Defensive	5.89	5.83
	Healthcare	12.39	12.51
	Utilities	1.96	2.31

Investment as of Jul 31, 2024 | Category: Large Blend as of Aug 31, 2024 | Sector data is based on the rescaled long position of the holdings. | Source: Holdings-based calculations.

Calvert US Large Cap Core Rspnb Idx I CISIX ★★★★ Morningstar Medalist Rating

Portfolio | Medalist Rating as of Apr 30, 2024 | See Eaton Vance Investment Hub >

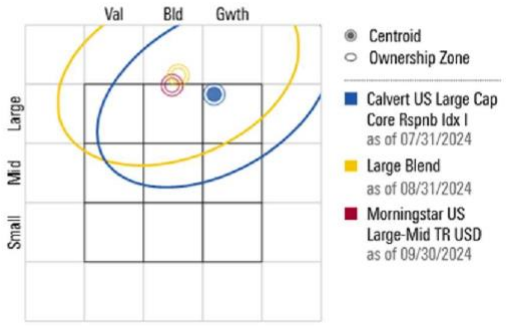
Portfolio

Asset Allocation

Asset Class	Investment	Category	Index
U.S. Equity	99.52	96.10	99.17
Non-U.S. Equity	0.31	2.41	0.83
Fixed Income	0.00	0.57	0.00
Other	0.00	1.05	0.00
Cash	0.17	1.55	0.00
Not Classified	0.00	0.03	0.00

Investment as of Jul 31, 2024 | Category: Large Blend as of Aug 31, 2024 | Index: Morningstar US Large-Mid TR USD as of Sep 30, 2024 | Source: Holdings-based calculations.

Stock Style Map Weight Historical



Holdings

Equity Holdings	Bond Holdings	Other Holdings
789	0	2

% Assets in Top 10 Holdings	Reported Turnover %	Women Directors %	Women Executives %
33	8.00 As of 09/30/23	35	27

Holdings	% Portfolio Weight	First Bought	Market Value as of Jul 31, 2024	Cur	Share Change %	1-Year Return	Forward P/E	Equity Star Rating
Apple Inc	6.83	Oct 31, 2000	370,771,887	USD	↓ 0.16	31.08	29.85	
Microsoft Corp	6.15	Oct 31, 2000	333,588,106	USD	↓ 0.16	30.56	31.55	
NVIDIA Corp	5.55	Oct 31, 2000	301,451,945	USD	↓ 0.17	165.46	31.25	
Alphabet Inc Class A	3.88	Sep 30, 2005	210,553,342	USD	↓ 0.23	23.92	18.94	
Amazon.com Inc	3.55	Oct 31, 2000	192,711,498	USD	0.00	42.72	31.25	
Broadcom Inc	1.60	Jun 30, 2018	86,788,088	USD	0.00	106.92	27.62	
Eli Lilly and Co	1.48	Sep 30, 2013	80,193,762	USD	0.00	66.47	39.22	
Tesla Inc	1.45	Sep 30, 2012	78,432,930	USD	0.00	-1.03	84.75	
JPMorgan Chase & Co	1.34	Jun 30, 2018	72,751,213	USD	0.00	47.24	12.27	
UnitedHealth Group Inc	1.20	Dec 31, 2023	65,176,948	USD	0.00	16.65	18.98	

Page 1 of 3 Viewing 1 to 10 of 25 Unlock to see full list

Holdings as of Jul 31, 2024 | The top 25 largest holdings are available for display across Equity, Bond and Other.

Nuveen Large Cap Responsible Eq R6 TISCX ★★★

Morningstar Medalist Rating

Sustainability | Medalist Rating as of Dec 28, 2023 | See Nuveen Investment Hub >

Quote | Chart | Fund Analysis | Performance | Sustainability | Risk | Price | Portfolio | People | Parent

Sustainability

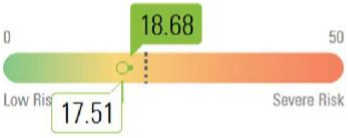
Risk | Values | Proxy Voting

Sustainability Rating

Low Carbon Designation

Low Carbon

Corporate Sustainability Score



● Historical ○ Current
┆ Global Category Average (Historical)

Sovereign Sustainability Score

● Historical ○ Current
┆ Global Category Average (Historical)

Carbon Risk Score

○ 12-Month Average ┆ Category Average
| Category Best/Worst

Sustainability

Risk | Values | Proxy Voting

Product Involvement

☐ Investment ▨ Category ⚠ Employs Exclusions

Nuveen Large Cap Responsible Eq R6 TISCX ★★★

Morningstar Medalist Rating

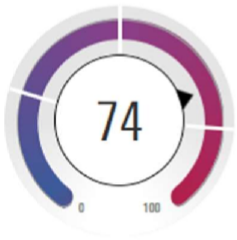
Risk | Medalist Rating as of Dec 28, 2023 | See Nuveen Investment Hub >

Quote | Chart | Fund Analysis | Performance | Sustainability | Risk | Price | Portfolio | People | Parent

Risk

3-Yr | 5-Yr | 10-Yr

Portfolio Risk Score



Risk Score	Risk Level
0–23	Conservative
24–47	Moderate
48–78	**Aggressive**
79–99	Very Aggressive
100+	Extreme

Morningstar Risk & Return

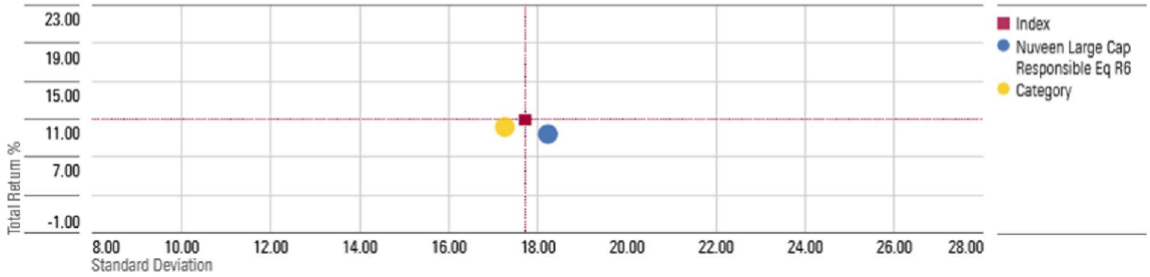
Risk vs. Category

Return vs. Category

Risk & Volatility Measures

Capture Ratios	Investment	Category	Index
Alpha	-2.44	-1.25	-0.92
Beta	1.03	0.95	1.01
R^2	98.02	93.52	99.81
Sharpe Ratio	0.38	0.43	0.46
Standard Deviation	18.22	17.26	17.72

Risk/Return Analysis



Exposure

Sector | Region | Country | vs. Category %

	Sectors	Investment %	Cat %
Cyclical	Basic Materials	2.65	2.59
	Consumer Cyclical	9.66	9.69
	Financial Services	15.15	13.39
	Real Estate	2.93	1.96
Sensitive	Communication Services	6.46	8.44
	Energy	2.13	3.71
	Industrials	9.89	9.78
	Technology	31.89	29.78
Defensive	Consumer Defensive	6.09	5.83
	Healthcare	12.03	12.51
	Utilities	1.14	2.31

Investment as of Jul 31, 2024 | Category: Large Blend as of Aug 31, 2024 | Sector data is based on the rescaled long position of the holdings. | Source: Holdings-based calculations.

Nuveen Large Cap Responsible Eq Premier TRPSX ★★★ Morningstar Medalist Rating

Portfolio | Medalist Rating as of Dec 28, 2023 | See Nuveen Investment Hub >

Quote Chart Fund Analysis Performance Sustainability Risk Price Portfolio People Parent

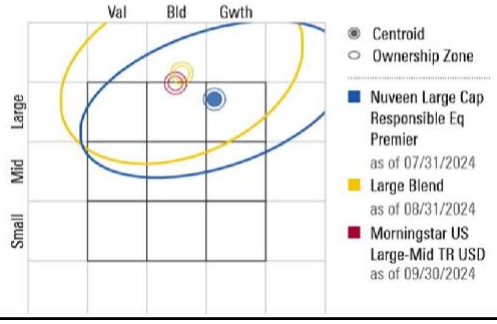
Portfolio

Asset Allocation

Asset Class	Investment	Category	Index
U.S. Equity	98.58	96.10	99.17
Non-U.S. Equity	0.89	2.41	0.83
Fixed Income	0.00	0.57	0.00
Other	0.00	1.05	0.00
Cash	0.52	1.55	0.00
Not Classified	0.00	0.03	0.00

Investment as of Jul 31, 2024 | Category: Large Blend as of Aug 31, 2024 | Index: Morningstar US Large-Mid TR USD as of Sep 30, 2024 | Source: Holdings-based calculations.

Stock Style Map | Weight | Historical



Holdings

Equity Holdings	Bond Holdings	Other Holdings
142	0	5

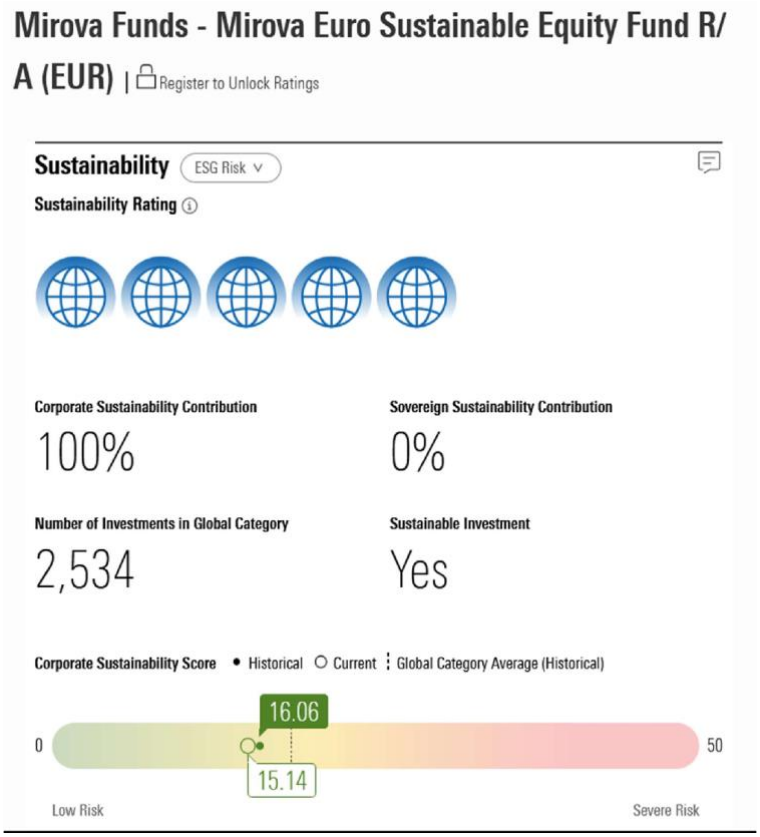
% Assets in Top 10 Holdings	Reported Turnover %	Active Share	Women Directors %	Women Executives %
28	15.00 As of 10/31/23	58.23	35	29

Holdings	% Portfolio Weight	First Bought	Market Value as of Jul 31, 2024	Cur	Share Change %	1-Year Return	Forward P/E	Equity Star Rating
Microsoft Corp	7.28	May 31, 2016	460,789,934	USD	↓ 0.57	33.87	31.45	
NVIDIA Corp	6.79	Aug 31, 2014	429,951,022	USD	↓ 0.42	182.37	32.36	
Tesla Inc	2.00	Jun 30, 2012	126,766,613	USD	↓ 8.24	-2.38	81.97	
JPMorgan Chase & Co	1.98	Mar 31, 2023	125,287,490	USD	↓ 1.83	46.89	12.15	
Eli Lilly and Co	1.98	May 31, 2018	125,228,860	USD	↓ 0.46	69.57	39.06	
UnitedHealth Group Inc	1.81	Nov 30, 2022	114,397,144	USD	↓ 4.62	17.91	19.01	
Visa Inc Class A	1.54	May 31, 2023	97,725,647	USD	↑ 0.96	21.91	24.81	
Mastercard Inc Class A	1.49	Mar 31, 2021	94,532,848	USD	↑ 0.22	27.22	29.76	
The Home Depot Inc	1.46	May 31, 2018	92,470,747	USD	↓ 2.37	44.01	26.11	
Procter & Gamble Co	1.44	Jun 30, 2002	91,349,941	USD	0.00	19.61	24.39	

Page 1 of 3 < > Viewing 1 to 10 of 25 **Unlock to see full list**

Holdings as of Jul 31, 2024 | The top 25 largest holdings are available for display across Equity, Bond and Other. Active Share as of Jul 31, 2024. Active Share index: iShares Russell 1000 ETF

Mirova Funds - Mirova Euro Sustainable Equity Fund R/A (EUR) | Register to Unlock Ratings



Mirova Funds - Mirova Euro Sustainable Equity Fund R/A (EUR) | Register to Unlock Ratings

Morningstar Rating™(Relative to Category)			31/08/2024
	Morningstar Return	Morningstar Risk	Morningstar Rating™
3-Year	Below Average	Average	★★
5-Year	Below Average	Average	★★
10-Year	Average	Below Average	★★★
Overall*	Average	Average	★★★

Category : Eurozone Large-Cap Equity

Click here to see our Methodology

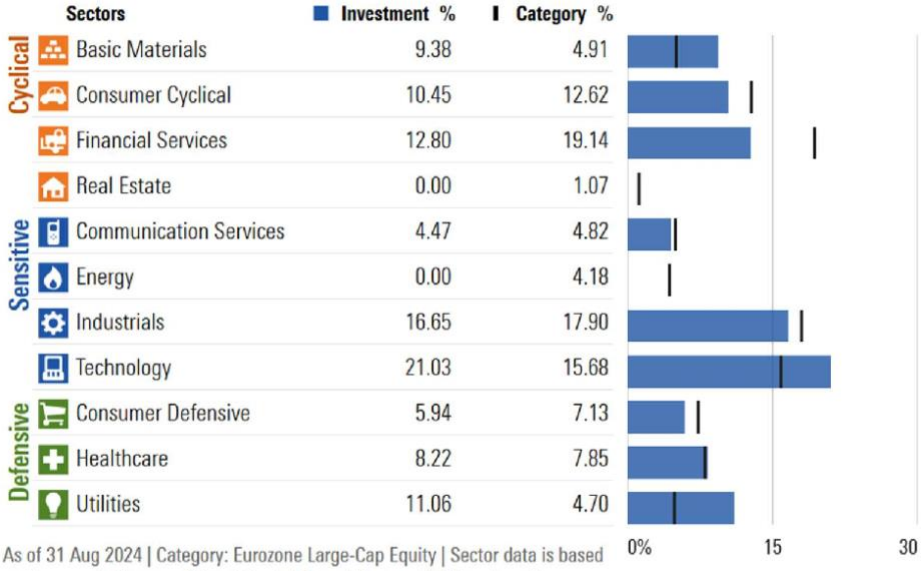
1 Year Daily Volatility Chart (annualised)

Performance history not available.

Volatility Measurements			30/09/2024
3-Yr Std Dev	13.54 %	3-Yr Sharpe Ratio	0.09
3-Yr Mean Return	4.52 %		

Modern Portfolio Statistics	30/09/2024 Standard Index	30/09/2024 Best Fit Index
	Morningstar DM Ezn TME NR EUR	Morningstar DM Ezn TME GR EUR
3-Yr Beta	0.98	0.98
3-Yr Alpha	-2.30	-3.50

Exposure Sector | Region | Country | vs. Category % ∨



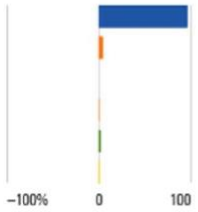
As of 31 Aug 2024 | Category: Eurozone Large-Cap Equity | Sector data is based on the rescaled long position of the holdings. | Source: Holdings-based calculations.

Mirova Funds - Mirova Euro Sustainable Equity Fund R/A (EUR)

Register to Unlock Ratings

Portfolio

Asset Allocation

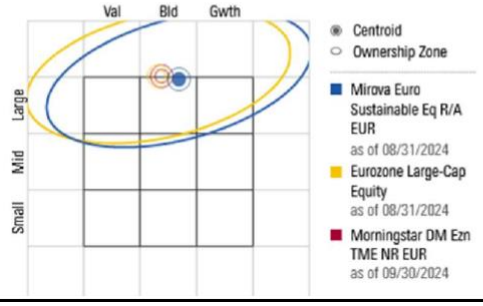


Asset Class	Net	Short	Long	Cat.	Index
Equity	95.46	0.00	95.46	97.41	100.00
Fixed Income	3.55	0.00	3.55	0.11	0.00
Preferred	0.00	0.00	0.00	0.13	0.00
Convertible	0.03	0.00	0.03	0.00	0.00
Cash	0.94	0.00	0.94	2.75	0.00
Other	0.02	0.01	0.03	1.56	0.00

Investment as of 31 Aug 2024 | Category: Eurozone Large-Cap Equity as of 31 Aug 2024 | Index: Morningstar DM Ezn TME NR EUR as of 30 Sept 2024 | Source: Holdings-based calculations.

Stock Style

Map | Weight | Historical



Holdings

Equity

Equity Holdings	Bond Holdings	Other Holdings	% Assets in Top 10 Holdings
40	0	3	42

Reported Turnover %	Active Share	Women Directors %	Women Executives %
—	65.23	42	23
As of —			

Holdings	% Portfolio Weight	First Bought	Market Value EUR as of 31 Aug 2024
ASML Holding NV	7.18	31 Dec 2014	73,210,732
SAP SE	5.33	30 Apr 2017	54,405,624
Hermes International SA	4.48	29 Feb 2016	45,666,126
Deutsche Telekom AG	4.19	31 Dec 2014	42,725,084
Iberdrola SA	4.05	30 Apr 2020	41,323,706
Siemens AG	3.66	31 Dec 2014	37,319,530
Air Liquide SA	3.47	31 Dec 2022	35,386,995
Allianz SE	3.27	31 Dec 2014	33,336,369
RELX PLC	3.25	30 Sept 2018	33,125,332
Munchener Ruckversicherungs-Gesellschaft AG	2.80	29 Feb 2016	28,614,753

Holdings as of 31 Aug 2024 | This investment's holding data is suppressed to show the top 10.

UBS (Lux) Equity Fund - Euro Countries Opportunity Sustainable (EUR) P-acc | Register to Unlock Ratings

Morningstar Rating™(Relative to Category) — 31/08/2024

	Morningstar Return	Morningstar Risk	Morningstar Rating™
3-Year	Below Average	Low	★★
5-Year	Average	Below Average	★★★
10-Year	Average	Low	★★★★
Overall	Average	Low	★★★

Category : Eurozone Large-Cap Equity

Click here to see our Methodology

1 Year Daily Volatility Chart (annualised)

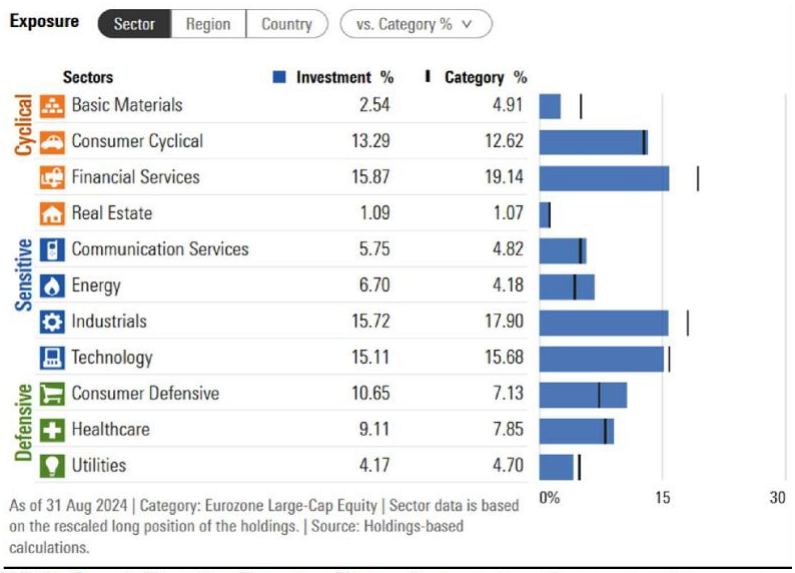
Performance history not available.

Volatility Measurements — 30/09/2024

3-Yr Std Dev	11.57 %	3-Yr Sharpe Ratio	-0.08
3-Yr Mean Return	2.41 %		

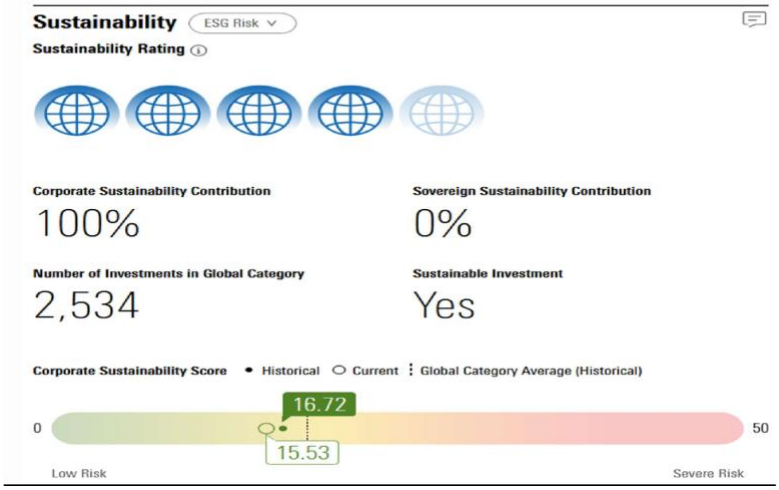
Modern Portfolio Statistics

	30/09/2024 Standard Index: Morningstar DM Ezn TME NR EUR	30/09/2024 Best Fit Index: Morningstar DM Eur xUK TME GR EUR
3-Yr Beta	0.82	0.90
3-Yr Alpha	-3.37	-4.45



As of 31 Aug 2024 | Category: Eurozone Large-Cap Equity | Sector data is based on the rescaled long position of the holdings. | Source: Holdings-based calculations.

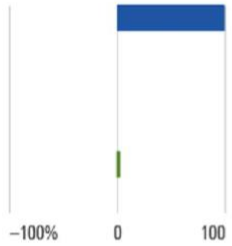
UBS (Lux) Equity Fund - Euro Countries Opportunity Sustainable (EUR) P-acc | Register to Unlock Ratings



UBS (Lux) Equity Fund - Euro Countries Opportunity Sustainable (EUR) P-acc | Register to Unlock Ratings

Portfolio

Asset Allocation

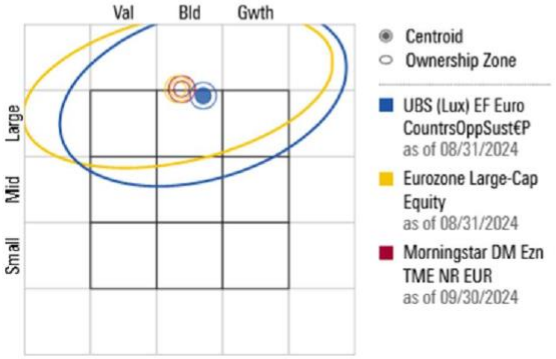


Asset Class	Net	Short	Long	Cat.	Index
Equity	98.69	0.00	98.69	97.41	100.00
Fixed Income	0.00	0.00	0.00	0.11	0.00
Preferred	0.00	0.00	0.00	0.13	0.00
Convertible	0.00	0.00	0.00	0.00	0.00
Cash	1.31	0.46	1.77	2.75	0.00
Other	0.00	0.00	0.00	1.56	0.00

Investment as of 31 Aug 2024 | Category: Eurozone Large-Cap Equity as of 31 Aug 2024 | Index: Morningstar DM Ezn TME NR EUR as of 30 Sept 2024 | Source: Holdings-based calculations.

Stock Style

Map | Weight | Historical



Holdings

Equity Holdings	Bond Holdings	Other Holdings	% Assets in Top 10 Holdings
53	0	16	41

Reported Turnover %	Active Share	Women Directors %	Women Executives %
108.47 As of 11/30/23	59.69	42	18

Holdings	% Portfolio Weight	First Bought	Market Value EUR as of 31 Aug 2024
ASML Holding NV	7.32	30 Nov 2017	42,975,100
Lvmh Moet Hennessy Louis Vuitton SE	5.66	31 Mar 2017	33,242,316
SAP SE	5.04	30 Apr 2010	29,557,954
Sanofi SA	4.27	30 Sept 2019	25,041,738
Iberdrola SA	4.03	31 Dec 2018	23,654,208
Schneider Electric SE	3.47	30 Apr 2019	20,354,406
TotalEnergies SE	3.10	31 Aug 2024	18,163,211
Koninklijke Philips NV	2.98	31 Jan 2023	17,482,643
Danone SA	2.81	31 Aug 2024	16,463,522
Allianz SE	2.67	31 Aug 2024	15,685,737

Holdings as of 31 Aug 2024 | This investment's holding data is suppressed to show the top 10.

Quantile regression results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001940	0.001362	-1.423818	0.1566
COVID_DEATHS	6.30E-09	2.67E-08	0.236024	0.8137
VIX	0.001812	0.005204	0.348154	0.7282
WTI	-0.016664	0.009948	-1.675170	0.0960
MSCI_WORLD	0.031530	0.030917	1.019852	0.3094
JOBLESS_CLAIMS	0.000568	0.000304	1.869370	0.0635

R-squared	0.052155	Mean dependent var	-0.001348
Adjusted R-squared	0.020561	S.D. dependent var	0.008959
S.E. of regression	0.008867	Akaike info criterion	-6.575332
Sum squared resid	0.011793	Schwarz criterion	-6.458030
Log likelihood	518.8759	Hannan-Quinn criter.	-6.527689
F-statistic	1.650759	Durbin-Watson stat	1.935836
Prob(F-statistic)	0.150043		

Dependent Variable: FUND_RETURN
Method: Panel Least Squares
Date: 09/25/24 Time: 07:11
Sample (adjusted): 1/14/2018 12/25/2022
Periods included: 259
Cross-sections included: 6
Total panel (balanced) observations: 1554

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000348	0.000559	0.622623	0.5336
COVID_DEATHS	-1.22E-08	1.39E-08	-0.876123	0.3811
VIX	0.005493	0.003210	1.711385	0.0872
WTI	-0.002374	0.006736	-0.352396	0.7246
JOBLESS_CLAIMS	-8.94E-05	0.000173	-0.516524	0.6056
MSCI_WORLD	0.780976	0.021753	35.90211	0.0000

R-squared	0.614665	Mean dependent var	0.000883
Adjusted R-squared	0.613421	S.D. dependent var	0.026001
S.E. of regression	0.016167	Akaike info criterion	-5.407896
Sum squared resid	0.404579	Schwarz criterion	-5.387245
Log likelihood	4207.935	Hannan-Quinn criter.	-5.400216
F-statistic	493.8573	Durbin-Watson stat	2.331667
Prob(F-statistic)	0.000000		

Period Test

Panel Period Heteroskedasticity LR Test
Equation: UNTITLED
Specification: FUND_RETURN C COVID_DEATHS VIX WTI JOBLESS_CLAIMS MSCI_WORLD
Null hypothesis: Residuals are homoskedastic

	Value	df	Probability
Likelihood ratio	1266.338	6	0.0000

LR test summary:

	Value	df
Restricted LogL	4207.935	1548
Unrestricted LogL	4841.104	1548

Unrestricted Test Equation:
Dependent Variable: FUND_RETURN
Method: Panel EGLS (Period weights)
Date: 09/25/24 Time: 07:46
Sample (adjusted): 1/14/2018 12/25/2022
Periods included: 259
Cross-sections included: 6

Dependent Variable: FUND_RETURN
Method: Quantile Regression (tau = 0.1)
Date: 09/25/24 Time: 10:14
Sample (adjusted): 1/21/2018 12/25/2022
Included observations: 1548 after adjustments
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.02991
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.018476	0.001110	-16.64513	0.0000
L_COVID_DEATHS	5.39E-08	2.83E-08	1.902367	0.0573
VIX	-0.006753	0.008255	-0.817963	0.4135
WTI	0.018019	0.009908	1.818672	0.0692
L_JOBLESS_CLAIMS	-7.28E-05	0.000278	-0.261907	0.7934
MSCI_WORLD	0.665143	0.035331	18.82603	0.0000

Pseudo R-squared	0.400295	Mean dependent var	0.000862
Adjusted R-squared	0.398350	S.D. dependent var	0.026048
S.E. of regression	0.023994	Objective	4.570026
Quantile dependent var	-0.024217	Restr. objective	7.620456
Sparsity	0.090688	Quasi-LR statistic	747.4781
Prob(Quasi-LR stat)	0.000000		

Dependent Variable: FUND_RETURN
Method: Quantile Regression (tau = 0.2)
Date: 09/25/24 Time: 10:17
Sample (adjusted): 1/21/2018 12/25/2022
Included observations: 1548 after adjustments
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.049423
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.010521	0.000839	-12.54370	0.0000
L_COVID_DEATHS	2.95E-08	1.69E-08	1.745811	0.0810
VIX	-0.003265	0.004521	-0.722227	0.4703
WTI	-0.002853	0.008803	-0.324062	0.7459
L_JOBLESS_CLAIMS	-3.92E-05	0.000357	-0.109960	0.9125
MSCI_WORLD	0.716599	0.039276	18.24520	0.0000

Pseudo R-squared	0.372875	Mean dependent var	0.000862
Adjusted R-squared	0.370841	S.D. dependent var	0.026048
S.E. of regression	0.019116	Objective	6.643646
Quantile dependent var	-0.013376	Restr. objective	10.59381
Sparsity	0.052693	Quasi-LR statistic	937.0751
Prob(Quasi-LR stat)	0.000000		

Dependent Variable: FUND_RETURN
Method: Quantile Regression (tau = 0.3)
Date: 09/25/24 Time: 10:17
Sample (adjusted): 1/21/2018 12/25/2022
Included observations: 1548 after adjustments
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.066215
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.005436	0.000618	-8.796424	0.0000
L_COVID_DEATHS	7.90E-09	1.24E-08	0.637956	0.5236
VIX	-0.000701	0.003709	-0.188946	0.8502
WTI	-0.008736	0.008680	-1.006447	0.3144
L_JOBLESS_CLAIMS	6.06E-05	0.000161	0.376848	0.7063
MSCI_WORLD	0.771071	0.040898	18.85374	0.0000

Pseudo R-squared	0.362225	Mean dependent var	0.000862
Adjusted R-squared	0.360157	S.D. dependent var	0.026048
S.E. of regression	0.017083	Objective	7.802746
Quantile dependent var	-0.005980	Restr. objective	12.23433
Sparsity	0.034125	Quasi-LR statistic	1236.797
Prob(Quasi-LR stat)	0.000000		

Dependent Variable: FUND_RETURN
Method: Quantile Regression (tau = 0.4)
Date: 09/25/24 Time: 10:17
Sample (adjusted): 1/21/2018 12/25/2022
Included observations: 1548 after adjustments
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.078965
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001864	0.000526	-3.541762	0.0004
L_COVID_DEATHS	-1.27E-08	1.08E-08	-1.174611	0.2403
VIX	-0.000456	0.004013	-0.113733	0.9095
WTI	-0.011232	0.008216	-1.367101	0.1718
L_JOBLESS_CLAIMS	6.18E-05	0.000152	0.406870	0.6842
MSCI_WORLD	0.799811	0.045288	17.66038	0.0000

Pseudo R-squared	0.349208	Mean dependent var	0.000862
Adjusted R-squared	0.347098	S.D. dependent var	0.026048
S.E. of regression	0.016413	Objective	8.386563
Quantile dependent var	-0.001260	Restr. objective	12.88670
Sparsity	0.029605	Quasi-LR statistic	1266.723
Prob(Quasi-LR stat)	0.000000		

Dependent Variable: FUND_RETURN
Method: Quantile Regression (tau = 0.6)
Date: 09/25/24 Time: 10:18
Sample (adjusted): 1/21/2018 12/25/2022
Included observations: 1548 after adjustments
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.078965
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003679	0.000469	7.849590	0.0000
L_COVID_DEATHS	-2.15E-08	1.05E-08	-2.048500	0.0407
VIX	0.010593	0.005253	2.016384	0.0439
WTI	-0.014608	0.007982	-1.830061	0.0674
L_JOBLESS_CLAIMS	0.000198	0.000181	1.093626	0.2743
MSCI_WORLD	0.880494	0.038454	22.89760	0.0000

Pseudo R-squared	0.346138	Mean dependent var	0.000862
Adjusted R-squared	0.344017	S.D. dependent var	0.026048
S.E. of regression	0.016686	Objective	8.164560
Quantile dependent var	0.005609	Restr. objective	12.48666
Sparsity	0.028016	Quasi-LR statistic	1285.602
Prob(Quasi-LR stat)	0.000000		

Dependent Variable: FUND_RETURN
Method: Quantile Regression (tau = 0.7)
Date: 09/25/24 Time: 10:19
Sample (adjusted): 1/21/2018 12/25/2022
Included observations: 1548 after adjustments
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.066215
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.007261	0.000544	13.33626	0.0000
L_COVID_DEATHS	-4.04E-08	1.19E-08	-3.405175	0.0007
VIX	0.013222	0.004971	2.659868	0.0079
WTI	-0.013542	0.007777	-1.741191	0.0818
L_JOBLESS_CLAIMS	0.000209	0.000157	1.332820	0.1828
MSCI_WORLD	0.888800	0.033716	26.36169	0.0000

Pseudo R-squared	0.350829	Mean dependent var	0.000862
Adjusted R-squared	0.348724	S.D. dependent var	0.026048
S.E. of regression	0.017629	Objective	7.405319
Quantile dependent var	0.009970	Restr. objective	11.40734
Sparsity	0.032242	Quasi-LR statistic	1182.148
Prob(Quasi-LR stat)	0.000000		

Dependent Variable: FUND_RETURN
Method: Quantile Regression (tau = 0.8)
Date: 09/25/24 Time: 10:19
Sample (adjusted): 1/21/2018 12/25/2022
Included observations: 1548 after adjustments
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.049423
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.011037	0.000653	16.89401	0.0000
L_COVID_DEATHS	-3.15E-08	1.54E-08	-2.048289	0.0407
VIX	0.017525	0.003982	4.401334	0.0000
WTI	-0.015129	0.008858	-1.707901	0.0879
L_JOBLESS_CLAIMS	0.000144	0.000199	0.721072	0.4710
MSCI_WORLD	0.852517	0.032527	26.20942	0.0000

Pseudo R-squared	0.362267	Mean dependent var	0.000862
Adjusted R-squared	0.360199	S.D. dependent var	0.026048
S.E. of regression	0.019442	Objective	6.083363
Quantile dependent var	0.016187	Restr. objective	9.539047
Sparsity	0.042912	Quasi-LR statistic	1006.614
Prob(Quasi-LR stat)	0.000000		

Dependent Variable: FUND_RETURN
Method: Quantile Regression (tau = 0.9)
Date: 09/25/24 Time: 10:19
Sample (adjusted): 1/21/2018 12/25/2022
Included observations: 1548 after adjustments
Huber Sandwich Standard Errors & Covariance
Sparsity method: Kernel (Epanechnikov) using residuals
Bandwidth method: Hall-Sheather, bw=0.02991
Estimation successfully identifies unique optimal solution

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.018100	0.001032	17.53202	0.0000
L_COVID_DEATHS	-5.73E-08	2.21E-08	-2.598567	0.0095
VIX	0.018304	0.007725	2.369271	0.0179
WTI	-0.019667	0.010591	-1.856921	0.0635
L_JOBLESS_CLAIMS	0.000265	0.000339	0.782223	0.4342
MSCI_WORLD	0.800015	0.030879	25.90766	0.0000

Pseudo R-squared	0.386286	Mean dependent var	0.000862
Adjusted R-squared	0.384296	S.D. dependent var	0.026048
S.E. of regression	0.023678	Objective	4.018734
Quantile dependent var	0.025404	Restr. objective	6.548218
Sparsity	0.081090	Quasi-LR statistic	693.1868
Prob(Quasi-LR stat)	0.000000		