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Environmental Innovation and the Performance of Healthcare Mutual Funds Under Economic Stress

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Abstract: Modern healthcare generates significant amounts of greenhouse gas emissions and waste, which pollute the global environment and damage human health. Healthcare firms could reduce these environmental emissions and waste by developing environmentally friendly technologies and production processes. However, the implementation of green innovations requires significant investments. Healthcare equity mutual funds could provide them financial resources whether this allows fund managers to comply with their fiduciary duties. Previous literature has examined the financial performance of healthcare mutual funds without considering the environmental practices that investees adopt. To understand this issue, we examined the effect of investees' environmental business practices on healthcare fund financial performance by considering different states of the economy. To this end, we obtained a sample of 148 global healthcare equity mutual funds from December 2015 to December 2022. Adopting the Fama–French model, our findings indicate that mutual funds improve financial performance when investee firms are in the initial phase of greening their processes and activities. However, the mutual funds invested in healthcare firms with advanced environmental practices achieve risk-adjusted returns similar to those invested in healthcare firms that implement conventional business management strategies. Furthermore, the financial performance of healthcare mutual funds is not significantly affected by the COVID-19 pandemic crisis at the aggregate level. Therefore, adopting environmental practices in the healthcare sector will not result in a loss of investor wealth from 2016 to 2022.

Keywords: healthcare mutual fund; financial performance; efficient resource use; environmental emission; environmental innovation; COVID-19 pandemic crisis

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1. Introduction

Determining the effect of investees' environmental practices on mutual fund financial performance has attracted the attention of the mutual fund literature [1–3]. This issue could be critical in the segment of mutual funds focused on the healthcare sector to advance toward a sustainable economy. Healthcare equity mutual funds invest predominantly in firms in a mix of industries, such as healthcare equipment and supplies, providers and services, technologies, and pharmaceuticals. Healthcare firms generate large amounts of greenhouse gas emissions and waste, which pollute the global environment and damage human health [4,5]. According to [6], around 4.40 percent of global carbon emissions come from the healthcare sector. The tasks and services contributing to these high GHG emissions are related to healthcare facilities and healthcare-owned vehicles, purchased energy sources, and the healthcare supply chain. These emissions and medical waste have been increasing since the COVID-19 pandemic period due to the growing number of hospitalizations and the need to use a large number of medical tests and disposable

personal protective equipment to prevent and mitigate infectious diseases, threatening sustainable development [7]. To reduce the global healthcare climate footprint, the United Nations promotes the twelfth Sustainable Development Goal (SDG 12), which focuses on responsible production and consumption. SDG 12 encourages healthcare firms to develop technological innovations that ensure the sustainable management of medical waste and lower carbon emissions associated with medical incinerators, efficient use of energy, or travel to healthcare facilities. It also urges key stakeholders, such as investors, to take immediate action to address the growing environmental concerns of the global society [7–9].

Institutional investors will invest in healthcare firms developing environmental projects only if these projects improve corporate financial performance and lead mutual fund managers to achieve positive risk-adjusted returns. According to modern portfolio theory [10], integrating environmental criteria into fund portfolio management restricts the investment universe while increasing search costs. This reduces the funds' financial performance. However, the restriction of the eligible investment universe also allows fund managers to select better environmentally managed healthcare firms. Healthcare firms could implement proactive and/or reactive environmental policies by developing or purchasing new green technologies from external healthcare device providers. These environmental policies reduce the firms' environmental risk and operational costs, but in a different way from a natural resource-based view of the firms [11]. This will affect healthcare firms' reputation and financial performance based on stakeholder theory [12]. Consequently, the financial performance of mutual funds investing in them will also be influenced. Although understanding how environmental practices adopted by healthcare firms influence financial performance could help managers select more profitable healthcare firms, the literature has not examined this. To fill this gap, this study examines the effect of investees' environmental business practices on the financial performance of healthcare funds by considering different states of the economy.

This study makes several contributions to the existing literature in several ways. Unlike other studies examining how the adoption of environmental screening in portfolio management affects the financial performance of funds diversified across economic sectors [1–3], this study examines the financial performance of mutual funds that invest mainly in the healthcare sector. While other authors have examined the financial performance of healthcare mutual funds, considering that they adopt traditional management portfolio strategies [13–17], this study examines the effect of several environmental criteria on healthcare mutual fund financial performance. Furthermore, most previous studies examining healthcare mutual fund financial performance, such as [13–15], implemented Carhart's [18] model, while this study also adopts Fama and French's [19] model, which provides a better fit.

The rest of this paper is organized as follows. Section 2 explains the literature review and develops the hypotheses. Section 3 describes the research method, sample, and financial performance evaluation models. Section 4 presents the empirical results. Finally, Section 5 presents the main conclusions and discusses the empirical results.

2. Literature Review and Hypotheses Development

Mutual fund literature examines the financial performance of healthcare mutual funds. Specifically, refs. [13,15,20–22] found that mutual healthcare funds can beat the market. However, more recent studies, such as [14,17], point out that most healthcare mutual funds reach financial performance similar to the benchmark market. Thus, fund managers face more difficulty finding undervalued healthcare firms in financial markets over time. These investment opportunities weaken when healthcare mutual fund managers integrate

environmental criteria into their portfolio management strategies to satisfy healthcare fund investors concerned about environmental issues. Consequently, according to modern portfolio theory, the portfolio's diversifiable risk and search and monitoring costs increase, lowering the fund's financial performance [1,10]. Supporting this theory, ref. [23] found that US green mutual funds underperformed their conventional counterparts during the 1987–2009 period, according to Carhart's model. Extending the sample to the European mutual fund industry, ref. [3] showed that US and European green mutual funds underperformed their market benchmark from 1996 to 2015. Similar empirical evidence is provided by [1] for Chinese green mutual funds. Implementing Carhart's model, these mutual funds could not beat the market during 2010–2016.

By contrast, according to stakeholder theory [12], healthcare mutual fund managers implementing environmental screening will likely improve their financial performance by selecting better-managed healthcare firms that develop environmental technologies to reduce environmental emissions and waste by using their resources efficiently. This lowers production and litigation costs and improves a firm's reputation and relationship with environmentally concerned stakeholders, thereby increasing the financial performance of healthcare firms and those of mutual funds investing in them [24,25]. Supporting this theory, ref. [26] pointed out that green funds in BRICS (Brazil, Russia, India, China, and South Africa) outperformed their counterparts during the 2011–2019 period, according to Carhart's model.

These incongruent results could be due to previous studies not considering that the financial benefits of investee firms' environmental activities depend on the implementation stage of the environmental management strategy [27]. In the early stages of environmental management systems, investee firms tried to minimize or eliminate emissions and waste from their operations by implementing (1) a reactive environmental management strategy focused on the use of pollution control equipment that retains, treats, and disposes of emissions and waste to comply with environmental regulations or (2) a proactive environmental management strategy focused on improving the total quality management system through material substitution, recycling, or process innovation, leading to efficient use of resources. From the natural resource-based view of the firm [11], better utilization of inputs reduces raw materials, energy, water, and waste disposal costs, as well as the firm's compliance and liability costs associated with significant emissions and waste reductions [28]. Through input cost reductions, healthcare firms gain a temporary competitive advantage that contributes to improving their financial performance and the financial performance of healthcare mutual funds investing in them.

When firms have obtained these short-term gains and pollution prevention practices become standard in the healthcare sector, it is more difficult to achieve additional emissions and waste reductions [29]. To enhance emission reduction and corporate environmental performance, firms must introduce significant changes in processes that require developing new production technology and product design, such as developing eco-designed products. Both environmental innovation practices require firms to make large investments in green R&D projects whose economic payoff may be neutral in the medium term and positive in the long term, but only if successful green projects allow healthcare firms to have valuable, rare, inimitable, and non-sustainable resources and capabilities that generate a sustained competitive advantage, as proposed by the natural resource-based view theory [11,27,30]. Given that the United Nations promulgated the Paris Agreement and the Sustainable Development Goals at the end of 2015, early movers in environmental practices could achieve neutral economic payoffs, causing no effect on the financial performance of funds investing in them, while later movers could be holding short-term gains that would benefit mutual funds investing in them. Therefore, we hypothesized the following:

H1a. *High green healthcare mutual funds achieve financial performance similar to that of their conventional counterparts.*

H1b. *Conventional and high green healthcare mutual funds underperform low green healthcare mutual funds.*

The effects of green practices on financial performance may vary across different market states. In this sense, there is consensus among previous authors pointing out that green mutual funds achieve better financial performance in crisis periods than in non-crisis periods across several geographical markets, such as the US [2,3,31] and Europe [2,3]. While these studies adopt Carhart's model on a sample, they cover different periods from 1994 to 2015, excluding the COVID-19 pandemic period. The COVID-19 infectious disease has had unprecedented consequences on human life, the economy, and the environment, affecting markets and government policies. Governments have devoted efforts to contain the COVID-19 outbreak, reducing the priorities of the Sustainable Development Goals and Paris Agreement goals [32]. Healthcare facilities have been accommodating a growing number of COVID-19 patients who need treatment or critical care, increasing the demand for respiratory monitors or digital healthcare technologies to mitigate the influence of the COVID-19 virus. Healthcare firms in the advanced phase of environmental research and development projects have difficulties stopping them and producing medical products and equipment to treat COVID-19 patients, as the COVID-19 pandemic negatively affects their financial performance and mutual funds invested in them. However, healthcare firms initiating environmental innovation projects could redirect resources to the COVID-19 response, producing innovations in respiratory monitors, personal protective equipment such as face masks and plastic gloves, and digital healthcare technologies, among others, to satisfy societal and medical demands and prevent COVID-19 expansion. This allowed them to maintain their sales and corporate financial performance during the COVID-19 pandemic.

Consequently, mutual funds investing in them maintained their financial performance during the COVID-19 crisis. Additionally, the massive production of personal protective equipment, medical devices, and digital healthcare technologies, along with the intervention of governments and healthcare insurance companies, stabilized prices in the healthcare sector during the COVID-19 pandemic period, contributing to the fact that the COVID-19 pandemic did not affect the financial performance of mutual funds invested in healthcare firms [33]. Therefore, we hypothesized the following:

H2a. *The COVID-19 pandemic negatively (neutrally) affected the financial performance of mutual healthcare funds with high (low) environmental innovation scores.*

H2b. *The COVID-19 pandemic did not affect healthcare funds' financial performance regarding the environmental dimension, resource use, and emission reduction sub-dimensions.*

3. Research Method

3.1. Sample

We obtain the data on mutual funds from the Refinitiv EIKON/Datastream databases. The global mutual funds categorized as sector equity healthcare mutual funds are identified using the Refinitiv EIKON database. Due to methodological issues, we exclude funds using passive investment strategies and funds that aggregate into one fund, such as index-based funds and multiple-share classes. After that, our sample included 243 primary healthcare equity mutual funds adopting active portfolio management strategies. For each mutual fund, we obtain the Lipper code, investment objective, and scores relative to environmental

category and resource use, emissions, and environmental innovation items at the end of 2022 from the Refinitiv EIKON database, as reported in Table 1. Specifically, resource use scores reflect the capacity of investee firms to enhance supply chain management by introducing eco-efficient practices that reduce the use of materials, energy, and water in the production process; the emission reduction score denotes the commitment and effectiveness of investee firms to reduce environmental emissions in their production process; and the environmental innovation score represents the capacity of investee firms to lower environmental costs by using greener environmental technologies and developing eco-designed products. The fund environmental score is a weighted sum of the resource use, emission reduction, and environmental innovation sub-dimension scores, whose weights vary per industry. The pillar weights are normalized to percentages oscillating between 0 and 100. The fund environmental and sub-dimension scores were obtained from the Refinitiv EIKON database. The software used is Stata 13.

Table 1. Summarized statistics.

Variable	Mean	Standard Deviation	Minimum	Maximum
Green healthcare funds				
ES	62.218	12.445	19.115	79.213
RUS	73.502	13.599	25.092	88.817
EES	69.662	13.379	20.654	86.527
EIS	21.377	8.122	1.030	43.593
Return	0.063	0.027	−0.065	0.131
TNA ($ Millions)	608.229	1290.350	1.000	8619.604
TER (%)	1.734	0.568	0.341	3.413
Conventional healthcare funds				
Return	0.053	0.029	−0.080	0.129
TNA ($ Millions)	166.210	273.430	0.004	1720.877
TER (%)	1.880	0.562	0.783	4.451

Using the Lipper code of each mutual fund, we take the monthly total return index expressed in US dollars from December 2015 to December 2022, the yearly total net assets under management expressed in US dollars, and the total expense ratio covering the period from December 2016 to December 2022 from the Refinitiv Datastream database. In 2015, the United Nations launched Sustainable Development Goals (SDGs), encouraging governments, civil society, and the private sector to collaborate to improve the environment and access to health systems for all people. The United Nations Declaration on SDGs came into effect in 2016. From December 2015 to December 2022, we identified a global crisis period that started with the COVID-19 public health emergency declaration by the World Health Organisation (WHO) in January 2020 and ended when the WHO considered that COVID-19 did not constitute a public health emergency of international concern in May 2023.

To ensure data quality, we removed mutual funds with less than 12 months of data and those with no or limited data [34]. Our final sample consisted of 148 healthcare mutual funds domiciled in Australia, Austria, Belgium, Brazil, Canada, Finland, France, Germany, Ireland, Japan, Korea, Luxembourg, Malaysia, the Netherlands, Norway, Saudi Arabia, Singapore, Slovenia, Spain, Sweden, Switzerland, Taiwan, Thailand, the UK, and the USA.

Additionally, we obtained the monthly total return index for the MSCI World Healthcare Index from the Refinitiv Datastream database, covering the period from December 2015 to December 2022. The one-month Treasury Bill rate, size, book-to-market ratio, oper-

ating profitability, and investment factors for the global market were taken from Kenneth's website from January 2016 to December 2022.

3.2. Methodology

3.2.1. The Effect of the Investee's Environmental Practices on Healthcare Fund Financial Performance

To examine the impact of investees' environmental practices on the financial performance of healthcare funds, we considered the level of environmental scores achieved by fund j at the end of 2022 as a distinguishing factor, similar to [35,36]. Thus, we classify healthcare funds by their environmental scores, which range from 0 to 100 points. Next, we group healthcare mutual funds into three categories: green funds with high environmental scores (high), green funds with low environmental scores (low), and funds without environmental scores (unspecified) or conventional funds. The high group includes mutual funds whose scores in the environmental dimension, resource use, emissions, or environmental innovation sub-dimensions are above the sample median at the end of 2022. The low group includes mutual funds whose scores in the environmental dimension, resource use, emissions, or environmental innovation sub-dimensions are equal to or below the sample median at the end of 2022. The unspecified group integrates the funds for which the Refinitiv company does not report data on environmental scores. Therefore, the mutual funds in this group lack information on resource use, emissions, and environmental innovation sub-dimensions.

This study estimates the financial performance of funds by implementing Fama and French's [19] model. This model may be a base model for studying the financial performance of mutual funds [37] because it overcomes the omitted factor bias detected in Jensen's [38] model by introducing operating profitability and investment risk factors, as well as the style factors proposed by [39], as follows:

$$R_{j,t} = \alpha_j + \beta_j MK_t + \gamma_j SMB_t + \delta_j HML_t + \theta_j RMW_t + \lambda_j CMA_t + \varepsilon_{p,t} \quad (1)$$

where $R_{j,t}$ is the return of fund j at time t adjusted by the risk-free rate; α_j represents the risk-adjusted return expressed in annualized terms for fund j in period t; MK_t is the market risk factor at time t using the MSCI World Healthcare index as market benchmark; SMB_t represents the size factor at time t; HML_t represents the value factor at time t; RMW_t represents the profitability factor at time t; CMA_t represents the investment factor at time t; β, γ, δ, θ, and λ represent the factor loadings corresponding to investment style factors, respectively; and $\varepsilon_{j,t}$ denotes the error term. Standard errors were calculated using Newey and West's [40] procedure.

Although previous literature has shown that Jensen's alpha estimations could be biased [41], this financial performance measure is usually used by fund managers, as reported by the Morningstar Company. It frequently appears in the financial press, which favors mutual fund investors using it to make investment decisions [37]. Therefore, Jensen's [38] model is implemented as follows:

$$R_{j,t} = \alpha_j + \beta_j MK_t + \varepsilon_{p,t} \quad (2)$$

where $R_{j,t}$ is the return of fund j at time t adjusted by the risk-free rate; α_j represents the risk-adjusted return expressed in annualized terms for fund j in period t; MK_t is the market risk factor at time t using the MSCI World Healthcare index as a market benchmark; β represents the factor loading corresponding to the market factor; and $\varepsilon_{j,t}$ denotes the error term. Standard errors were calculated using Newey and West's [40] procedure.

To check the robustness of the estimation results, we adopted Carhart's [18] model, which extends Fama and French's [39] model by introducing the momentum factor as follows:

$$R_{j,t} = \alpha_j + \beta_j MK_t + \gamma_j SMB_t + \delta_j HML_t + \varnothing_j MOM_t + \varepsilon_{p,t} \quad (3)$$

where $R_{j,t}$ is the return of fund j at time t adjusted by the risk-free rate; α_j represents the risk-adjusted return expressed in annualized terms for fund j in period t; MK_t is the market risk factor at time t using the MSCI World Healthcare index as market benchmark; SMB_t represents the size factor at time t; HML_t represents the value factor at time t; MOM_t represents the momentum factor at time t; β, γ, δ, and $\varnothing$ represent the factor loadings corresponding to investment style and momentum factors, respectively; and $\varepsilon_{j,t}$ denotes the error term. Standard errors were calculated using Newey and West's [40] procedure.

The financial performance of each healthcare mutual fund group (high, low, and unspecified) for each environmental dimension or sub-dimension (resource use, emissions, and environmental innovation) was compared with that of its counterpart by adopting Student's *t*-test for the independent samples, similar to [42].

3.2.2. The Effect of the COVID-19 Health Crisis on Healthcare Mutual Fund Financial Performance by the Investee's Environmental Practices

Different market states influence funds' financial performance, as shown in [3,31,43]. For this reason, we analyzed the effect of the COVID-19 health crisis on healthcare fund financial performance, considering investees' environmental practices, using Fama and French's [19] model as the base model. This model performs better than Jensen's [38] and Carhart's [18] models, according to the R-squared measure provided in Tables 2–4. Fama and French's [19] model was extended by adding a dummy variable that measures the effect of the COVID-19 health crisis on funds' financial performance, as follows:

$$R_{j,t} = \alpha_{j,nc} + \alpha_{j,C19} D_t + \beta_j MK_t + \gamma_j SMB_t + \delta_j HML_t + \theta_j RMW_t + \lambda_j CMA_t + +\varepsilon_{p,t} \quad (4)$$

where $R_{j,t}$ is the return of fund j at time t obtained as the Napierian logarithm of the quotient between total return index at time t and $t-1$ adjusted by the risk-free rate; $\alpha_{j,nc}$ represents the risk-adjusted return expressed in annualized terms for fund j during the pre-health crisis period; $\alpha_{j,C19}$ represents the variation of risk-adjusted return expressed in annualized terms for fund j during the COVID-19 health crisis period; and D_t is a variable dummy taking a value of one during the COVID-19 health crisis period and zero otherwise. Other variables were measured as previously described. Standard errors were calculated using Newey and West's [40] procedure.

For each mutual fund group (high, low, and unspecified) in each environmental dimension and sub-dimension (resource use, emissions, and environmental innovation), we compared the fund financial performance achieved during the pre-pandemic period with that achieved during the COVID-19 health crisis period using Student's *t*-test for independent samples.

Table 2. The five-factor financial performance of healthcare mutual funds investing in global geographical markets according to environmental dimensions score from 2016 to 2022.

Dimension/Sub-Dimension	Group	Annualized Financial Performance				R-Squared	Number of Estimates +/0/−	Number of Funds
		Mean	Standard Deviation	Max	Min			
Environmental (ES)	High	−0.0146	0.0178	0.0309	−0.0465	0.9147	1/21/6	28
	Low	0.0060	0.0343	0.1140	−0.0859	0.8480	2/25/2	29
	Unspecified	−0.0133	0.0279	0.0774	−0.0909	0.8466	1/73/17	91
	Full	−0.0098	0.0288	0.1140	−0.0909	0.8598	4/119/25	148
Resource Use (RUS)	High	−0.0143	0.0180	0.0309	−0.0465	0.9105	1/21/6	28
	Low	0.0057	0.0343	0.1140	−0.0859	0.8521	2/25/2	29
	Unspecified	−0.0133	0.0279	0.0774	−0.0909	0.8466	1/73/17	91
Emission Reduction (ERS)	High	−0.0139	0.0181	0.0309	−0.0465	0.9100	1/21/6	28
	Low	0.0054	0.0345	0.1140	−0.0859	0.8525	2/25/2	29
	Unspecified	−0.0133	0.0279	0.0774	−0.0909	0.8466	1/73/17	91
Environmental Innovation (EIS)	High	−0.0108	0.0244	0.0660	−0.0465	0.8958	2/20/6	28
	Low	0.0023	0.0321	0.1140	−0.0859	0.8663	1/26/2	29
	Unspecified	−0.0133	0.0279	0.0774	−0.0909	0.8466	1/73/17	91

Table 3. Student's *t*-test results.

Dimension/ Sub-Dimension	Group	Five-Factor Model Student's *t*-Test [CI]	CAPM Model Student's *t*-Test [CI]	Four-Factor Model Student's *t*-Test [CI]
Environmental (ES)	High-Low	−2.809 *** [−0.0354–(−0.0058)]	2.284 ** [0.0020–0.0330]	−1.117 [−0.0202–0.0057]
	High-Unspecified	−0.281 [−0.0103–0.0077]	5.021 *** [0.0141–0.0326]	1.808 ** [−0.008–0.0179]
	Low-Unspecified	3.035 *** [0.0067–0.0319]	0.845 [−0.0078–0.0195]	2.938 *** [0.0051–0.0264]
Resource Use (RUS)	High-Low	−2.729 *** [−0.0349–(−0.0052)]	2.305 ** [0.0022–0.0331]	−0.977 [−0.0193–0.0067]
	High-Unspecified	−0.222 [−0.0101–0.0081]	5.033 *** [0.0142–0.0327]	1.898 * [−0.0004–0.0184]
	Low-Unspecified	2.994 *** [0.0065–0.0317]	0.834 [−0.0079–0.0194]	2.860 *** [0.0047–0.0259]
Emission Reduction (ERS)	High-Low	−2.610 ** [−0.0342–(−0.0044)]	2.369 ** [0.0027–0.0335]	−0.878 [−0.0187–0.0073]
	High-Unspecified	−0.108 [−0.0118–0.0106]	5.076 *** [0.0144–0.0329]	1.964 * [−0.0001–0.0187]
	Low-Unspecified	2.929 *** [0.0061–0.0313]	0.804 [−0.0081–0.0192]	2.801 *** [0.0044–0.0256]
Environmental Innovation (EIS)	High-Low	−1.704 * [−0.0286–0.0023]	2.071 ** [0.0005–0.0318]	−0.151 [−0.0140–0.0121]
	High-Unspecified	0.426 [−0.0092–0.0142]	3.548 *** [0.0100–0.0353]	2.359 ** [0.0019–0.0215]
	Low-Unspecified	2.509 ** [0.0033–0.0280]	0.970 [−0.0068–0.0197]	2.452 ** [0.0024–0.0229]

The *p*-values for significance at the 1%, 5%, and 10% levels are indicated using the ***, **, and * notation, respectively. CI represents the confidence interval.

Table 4. The CAPM financial performance of healthcare mutual funds investing in global geographical markets according to environmental dimensions score from 2016 to 2022.

Dimension/Sub-Dimension	Group	Annualized Financial Performance				R-Squared	Number of Estimates +/0/−	Number of Funds
		Mean	Standard Deviation	Max	Min			
Environmental (ES)	High	−0.0231	0.0174	0.0105	−0.0638	0.8960	0/17/11	28
	Low	−0.0406	0.0365	0.0197	−0.1848	0.7411	0/23/6	29
	Unspecified	−0.0464	0.0306	0.0092	−0.1692	0.7675	0/48/43	91
	Full	−0.0409	0.0312	0.0197	−0.1848	0.7866	0/88/60	148
Resource Use (RUS)	High	−0.0230	0.0174	0.0105	−0.0638	0.8904	0/17/11	28
	Low	−0.0407	0.0364	0.0197	−0.1848	0.7466	0/23/6	29
	Unspecified	−0.0464	0.0306	0.0092	−0.1692	0.7675	0/48/43	91
Emission Reduction (ERS)	High	−0.0228	0.0174	0.0105	−0.0638	0.8898	0/18/10	28
	Low	−0.0409	0.0363	0.0197	−0.1848	0.7472	0/22/7	29
	Unspecified	−0.0464	0.0306	0.0092	−0.1692	0.7675	0/48/43	91
Environmental Innovation (EIS)	High	−0.0238	0.0245	0.0197	−0.0801	0.8658	0/19/9	28
	Low	−0.0399	0.0326	−0.0093	−0.1848	0.7704	0/21/8	29
	Unspecified	−0.0464	0.0306	0.0092	−0.1692	0.7675	0/48/43	91

4. Results

4.1. Results for the Effect of Fund Environmental Scores on Healthcare Fund Financial Performance

Table 2 reports the descriptive statistics of healthcare fund financial performance for each mutual fund group (high, low, and unspecified) considered in the environmental dimension and the resource use, emission reduction, and environmental innovation sub-dimensions obtained from Equation (1) using the MSCI World Healthcare index as the market benchmark. Complementing this, Table 3 presents the Student's *t*-test for the difference in means between the high-, low-, and unspecified groups for each dimension and sub-dimension. For the full sample, the results reveal that healthcare mutual funds achieved an annualized risk-adjusted return of −0.98% on average during 2016–2022. At the individual fund level, only 2.70% achieved a significantly positive risk-adjusted return, 16.89% of the sample significantly underperformed in the market, and 80.41% presented neutral financial performance. This finding is congruent with that of [44], which pointed out that, in general, healthcare mutual funds have not generated value above the market for their investors.

Considering the environmental dimension, the results show no significant differences in the financial performance achieved by green healthcare funds with high environmental scores (−1.46%) and conventional healthcare funds (−1.33%) at the aggregate level, confirming hypothesis H1a. However, both underperform their counterparts with low environmental scores, whose annualized mean risk-adjusted return increases significantly to 0.60% at the 0.01 level, which is congruent with Hypothesis H1b. These results are driven by 21.43% green healthcare funds with high environmental dimension scores and 18.68% conventional funds, which significantly underperform market benchmarks at the individual level. Only 6.90% of the green healthcare funds with low environmental scores achieved negative and statistically significant risk-adjusted returns. Furthermore, 6.90% of healthcare funds with low environmental scores significantly outperformed the market. In contrast, only 3.57% of the high environmental score fund group and 1.10% of healthcare funds without environmental scores outperformed the market. Thus, most healthcare mutual funds achieve a neutral financial performance. These findings are congruent with those of [3,23], which showed that most green mutual funds achieve neutral and negative risk-adjusted returns.

Similar evidence is found when comparing fund financial performance with high, low, and unspecified levels of resource use, emission reduction, and environmental innovation sub-dimensions, as reported in Tables 2 and 3. For the resource use sub-dimension, we find that healthcare mutual funds with low exposure to resource use achieve significantly higher mean risk-adjusted returns (0.57%) than their counterparts highly exposed to resource use, whose mean risk-adjusted return is −1.43%. While healthcare mutual funds with low resource use scores, on average, significantly outperform their counterparts with unspecified resource use information (−1.33%), the latter performs similarly to mutual funds with high resource use scores. These findings confirm H1a and H1b. Most funds with resource use scores perform similarly to market benchmarks at the individual fund level. Only 3.57% of healthcare mutual funds with high resource-use score levels and 6.90% of funds with low resource-use score levels were able to beat the market. In comparison, 21.43% of the funds with high resource-use score levels and 18.68% with low resource-use score levels significantly underperformed the market benchmark.

These results hardly differ from those achieved for the emission reduction sub-dimension, as shown in Tables 2 and 3. Thus, most mutual funds with a high (low) exposure to efficient resource use also have high (low) scores in the emission reduction sub-dimension, suggesting that most investee healthcare firms implement a proactive

environmental management strategy that allows them to achieve similar improvement levels in the efficient use of resources, environmental emissions, and waste reduction. These findings support H1a and H1b and are also congruent with [45–47], which point out that the efficient use of resources allows healthcare firms to reduce waste and emissions, favoring the achievement of the Paris Agreement's goals.

The results changed slightly for the environmental innovation sub-dimension, as shown in Tables 2 and 3. At the aggregate fund level, healthcare mutual funds with low environmental innovation scores significantly outperform their counterparts with high environmental innovation scores, achieving average risk-adjusted returns of 0.23% and −1.08%, respectively, confirming hypothesis H1b. Additionally, funds highly exposed to environmental innovation and those with unspecified environmental information achieve similar financial performance, thus supporting H1a. However, mutual funds without environmental innovation information perform significantly worse on average than their counterparts with low environmental innovation scores, which is congruent with H1b. These results are driven by 21.43% of the funds with high environmental innovation sub-dimension scores and 18.68% with unspecified environmental innovation scores, which significantly underperform the market benchmark at the individual level. Only 6.90% of mutual funds with low levels of environmental innovation significantly underperform the market benchmark. Mutual funds beating the market benchmark represent 3.45% of the low environmental innovation group and 7.14% of the high environmental innovation group.

Considering the similar results obtained for the resource use, emissions, and environmental innovation sub-dimensions, it appears that most mutual funds invest in healthcare firms that adopt pollution prevention practices aimed at improving, in similar proportions, the efficient use of resources, emissions, and waste reduction. When investee firms obtain short-term gains from the pollution prevention strategy, most develop eco-designed products and greener technologies that change their production processes, as the mean environmental innovation score is below the mean resource use or emission reduction scores in Table 1. However, some mutual funds highly exposed to environmental innovation with low resource use and emissions scores select healthcare firms that develop eco-designed products while paying less attention to the environmental impact of their production processes. Other mutual funds with low environmental innovation and high exposure to resource use and emissions select healthcare firms that purchase green technologies for their production processes.

To ensure robustness, we checked the sensitivity of our results to the model specifications. Specifically, we estimated risk-adjusted returns using Jensen's [38] and Carhart's [18] models, represented in Equations (2) and (3), respectively, and grouped mutual funds by their level on the environmental dimension and the resource use, emissions, or environmental innovation sub-dimensions. As seen in Tables 3–5, the results are sensitive to the financial performance measure used, confirming that (1) the omitted factors in Jensen's [38] model generate biased estimators and (2) Fama and French's [19] model provides better descriptions of risk-adjusted returns than Carhart's [18] model, the former performing better than Carhart's model, as indicated by [19].

Table 5. The four-factor financial performance of healthcare mutual funds investing in global geographical markets according to environmental dimensions score from 2016 to 2022.

Dimension/Sub-Dimension	Group	Annualized Financial Performance				R-Squared	Number of Estimates +/0/−	Number of Funds
		Mean	Standard Deviation	Max	Min			
Environmental (ES)	High	−0.0196	0.0158	0.0155	−0.0517	0.9081	1/20/7	28
	Low	−0.0124	0.0298	0.0445	−0.1225	0.8092	0/26/3	29
	Unspecified	−0.0281	0.0232	0.0376	−0.0840	0.8223	0/66/25	91
	Full	−0.0234	0.0243	0.0445	−0.1225	0.8359	1/112/35	148
Resource Use (RUS)	High	−0.0191	0.0162	0.0155	−0.0517	0.9032	1/20/7	28
	Low	−0.0128	0.0297	0.0445	−0.1225	0.8139	0/26/3	29
	Unspecified	−0.0281	0.0232	0.0376	−0.0840	0.8223	0/66/25	91
Emission Reduction (ERS)	High	−0.0188	0.0162	0.0155	−0.0517	0.9027	1/20/7	28
	Low	−0.0131	0.0297	0.0445	−0.1225	0.8144	0/26/3	29
	Unspecified	−0.0281	0.0232	0.0376	−0.0840	0.8223	0/66/25	91
Environmental Innovation (EIS)	High	−0.0164	0.0214	0.0445	−0.0517	0.8848	1/21/6	28
	Low	−0.0154	0.0267	0.0383	−0.1225	0.8317	0/25/4	29
	Unspecified	−0.0281	0.0232	0.0376	−0.0840	0.8223	0/66/25	91

4.2. Results for the Effect of the COVID-19 Health Crisis on Healthcare Mutual Fund Financial Performance by Investees' Environmental Practices

Table 6 reports the descriptive statistics for the annualized alpha coefficients for each mutual fund group (high, low, and unspecified) in the environmental dimension and the resource use, emissions, and environmental innovation sub-dimensions obtained from Equation (4) using the MSCI World Healthcare index as a market benchmark during the pre-pandemic period (January 2016–December 2019) and the risk-adjusted return variations during the COVID-19 pandemic crisis period. Furthermore, this table also presents the Student's *t*-test for the difference in means between financial performance achieved during the pre-crisis period and that obtained during the COVID-19 crisis period in each group by the environmental dimension and the sub-dimensions.

The total sample shows that the COVID-19 pandemic crisis did not affect the risk-adjusted returns achieved by healthcare mutual funds at the aggregate fund level. This supports H2b and is congruent with [16]. However, the COVID-19 effect on financial performance was significant and positive (negative) for 7.43% (4.73%) of healthcare mutual funds at the individual fund level. This finding is incongruent with [48], likely due to differences in the sample and methodology implemented. When observing healthcare mutual funds with high, low, and unspecified scores for the environmental dimension, we find that they performed similarly during the pre-COVID-19 crisis than during the COVID-19 crisis at the aggregate level. For the group with a high environmental score, 75.00% of healthcare mutual funds achieved financial performance similar to that of the market. In contrast, the remaining 25% underperformed the market benchmark during the pre-COVID-19 crisis period at the individual fund level. Although financial performance improved significantly for 3.57% of healthcare mutual funds with high environmental scores, it decreased significantly for 10.71% of them during the COVID-19 crisis period.

Similarly, our results indicate that 6.90% of healthcare mutual funds with low environmental scores can beat the market, while 3.45% underperform the market benchmark during the non-crisis period. The risk-adjusted return is significantly positive for 6.90% of the funds, and significantly negative for 10.34% of them during the COVID-19 crisis period. For the group without environmental information, we find that 3.30% of healthcare mutual funds outperform the market benchmark, while 23.08% of them achieve negative and significant financial performance. At the same time, the remaining firms perform similarly to the market during the non-crisis period. However, their financial performance increases significantly for 8.79% of funds, while it decreases significantly for only 1.10% of them.

For the resource use and emission reduction sub-dimension, the COVID-19 pandemic crisis did not affect the risk-adjusted returns for funds belonging to high or low environmental policy groups at the aggregate level. During the non-crisis period, no mutual funds with high resource use or emission reduction scores could beat the market, while 25% of them underperformed the market benchmark. During the COVID-19 crisis period, 3.57% of funds highly exposed to resource use or emission reduction practices significantly improved their financial performance, whereas it decreased for 14.29% of them. For the group with low resource use or emission reduction scores, 6.90% of funds significantly outperformed the market benchmark, but only 3.45% underperformed during the non-crisis period. During the COVID-19 crisis period, healthcare fund managers improved the financial performance of 6.90% of funds, while performance significantly declined for 6.90% of them.

Table 6. The five factors of financial performance of healthcare mutual funds according to environmental dimensions score in different market states.

Dimension	Group	Annualized Financial Performance				R-Squared	Number of Estimates +/0/−	Number of Funds	Student's *t*-Test [CI]
		Mean	Standard Deviation	Max	Min				
Environmental (ES)	High	−0.0117	0.0186	0.0313	−0.0431	0.9158	0/21/7	28	0.846
	$High_{CE}$	−0.0058	0.0327	0.0474	−0.0864		1/24/3		[−0.080–0.0195]
	Low	0.0076	0.0446	0.1550	−0.0693	0.8501	2/26/1	29	0.094
	Low_{CE}	−0.0012	0.0571	0.1068	−0.1225		2/24/3		[−0.0237–0.0260]
	Unspecified	−0.0119	0.0413	0.1091	−0.1141	0.8481	3/67/21	91	−0.018
	$Unspecified_{CE}$	0.0001	0.0526	0.1100	−0.2242		8/82/1		[−0.0115–0.0113]
	Full	−0.0080	0.0396	0.1550	−0.1141	0.8613	5/114/29	148	0.275
	$Full_{CE}$	−0.0013	0.0504	0.1100	−0.2242		11/130/7		[−0.0077–0.0102]
Resource Use (RUS)	High	−0.0095	0.0222	0.0541	−0.0431	0.9120	0/21/7	28	1.444
	$High_{CE}$	−0.0107	0.0389	0.0474	−0.1225		1/23/4		[−0042–0.0255]
	Low	0.0054	0.0438	0.1550	−0.0693	0.8538	2/26/1	29	−0.297
	Low_{CE}	0.0036	0.0523	0.1068	−0.1224		2/25/2		[−0.0276–0.0205]
Emission Reduction (ERS)	High	−0.0091	0.0221	0.0541	−0.0431	0.9115	0/21/7	28	1.430
	$High_{CE}$	−0.0106	0.0390	0.0474	−0.1225		1/23/4		[−0.0043–0.0255]
	Low	0.0051	0.0440	0.1550	−0.0693	0.8543	2/26/1	29	−0.291
	Low_{CE}	0.0035	0.0523	0.1068	−0.1224		2/25/2		[−0.0276–0.0206]
Environmental Innovation (EIS)	High	0.0018	0.0388	0.1550	−0.0384	0.8977	2/21/5	28	2.554 **
	$High_{CE}$	−0.0246	0.0432	0.0351	−0.1225		0/23/5		[0.0053–0.0439]
	Low	−0.0054	0.0321	0.0959	−0.0693	0.8676	0/26/3	29	−1.650
	Low_{CE}	0.0170	0.0407	0.1068	−0.0959		3/25/1		[−0.0376–0.0036]

The *p*-values for significance at the 1%, 5%, and 10% levels are indicated using the ***, **, and * notations, respectively. CI represents the confidence interval.

For the environmental innovation sub-dimension, the results show that healthcare mutual funds belonging to high groups significantly reduced their financial performance during the COVID-19 crisis period, while their counterparts, with low exposure to environmental innovation, reached similar financial performance during the non-crisis period as during the COVID-19 crisis period. This result is congruent with H2a. After high investments in environmental innovation projects during the pre-crisis period, investee firms found it difficult to stop these green projects due to their high cost and to lead their efforts to develop healthcare or telemedicine technologies or healthcare products necessary to detect, control, and mitigate the COVID-19 pandemic. This negatively affected their financial performance and the mutual funds investing in them during the COVID-19 crisis.

However, investee firms with low investment in environmental projects could reorganize their activities to satisfy the demand for respiratory monitors or digital healthcare technologies to mitigate the influence of the COVID-19 virus. This would allow healthcare firms to maintain their financial performance during the COVID-19 crisis period and the financial performance of the mutual funds invested in them (Sharma et al., 2022) [33]. At the individual fund level, 7.14% of the funds highly exposed to environmental innovation beat the market, while 17.86% underperformed the market benchmark during the non-crisis period. However, none of the funds improved their risk-adjusted returns, and 17.86% reduced their financial performance during the COVID-19 crisis period. For the group with a low environmental innovation level, none of the healthcare mutual funds beat the market, while 10.34% underperformed during the non-crisis period. This financial performance improved for 10.34% of healthcare mutual funds but decreased significantly for only 3.45% of them during the COVID-19 crisis.

5. Discussion

According to Fama and French's [19] model, most healthcare mutual funds perform similarly to the market. At the aggregate level, the risk-adjusted return shows no differences between healthcare funds with high levels of environmental, resource use, emissions, or environmental innovation scores and their counterparts with unspecified environmental information; however, both underperform green healthcare mutual funds with low scores on environmental dimensions and sub-dimensions. Thus, mutual funds investing in healthcare-related firms that implement business strategies with low environmental impact allow them to obtain their short-term gains. However, when investee firms advance towards potential long-term environmental targets that require large investments, the mutual funds invested in them perform similarly to conventional healthcare mutual funds. The average financial performance of healthcare funds and the number of funds with significant financial performance were similar across the environmental dimensions and sub-dimensions. Thus, most investee firms deploy similar efforts to reduce the use of resources and environmental emissions in the production process. After achieving short-term gains, they implement environmental innovation strategies to develop green environmental technologies and design green products. These findings support the natural resource-based view of the firm [11] and the stakeholder theory [12], given that mutual funds integrating environmental criteria into their portfolio management strategy do not reduce their risk-adjusted returns.

The COVID-19 pandemic did not affect the risk-adjusted return achieved by healthcare mutual funds across the environmental dimensions, resource use, and environmental emission sub-dimensions at the aggregate fund level, as in [16]. However, mutual funds highly exposed to environmental innovation showed reduced financial performance during the COVID-19 pandemic crisis, while their counterparts with lower scores remained unaffected. Thus, investee firms with significant investments in environmental innova-

tion projects had difficulty stopping them and driving their efforts to satisfy the demand for products and technologies that mitigated the effects of COVID-19 on the population. However, investee firms with low environmental innovation scores or those without environmental information could redirect their innovations to satisfy the needs generated by the COVID-19 illness.

6. Conclusions

Mutual funds for healthcare equity can help mitigate the environmental damage caused by healthcare firms. Mutual funds accumulate large assets, allowing them to invest in firms that develop environmental technologies to reduce the use of resources and environmental emissions in their business activities. However, they will only invest in these business activities when these investments allow them to increase the wealth of their retail investors. According to modern portfolio theory [10], mutual funds adopting environmental criteria increase their diversifiable risk and search costs, decreasing their financial performance. However, from a natural resource-based view of the firm [11], mutual funds adopting environmental criteria reduce their environmental risks, which enhances their financial performance.

Understanding how adopting environmental business practices affects fund financial performance will allow fund managers to select those healthcare firms adopting environmental business practices that generate high financial returns. To check this issue, this study examines the effects of several environmental innovation practices adopted by investee firms on the financial performance of healthcare mutual funds, considering different states of the economy. To this end, we obtained a sample of 148 global healthcare equity mutual funds using data from December 2015 to December 2022. These mutual funds were classified into three groups (high, low, and unspecified) based on their relative levels of the three environmental portfolio attributes (efficient use of resources, reducing environmental emissions and waste, and developing environmental innovations). For each mutual fund, we estimated the risk-adjusted returns using the Fama and French [19], Carhart [18], and Jensen [38] models.

Our findings indicate that mutual funds improve financial performance when investee firms are in the initial phase of greening their processes and activities. However, the mutual funds invested in healthcare firms with advanced environmental practices achieve risk-adjusted returns similar to those invested in healthcare firms that implement conventional business management strategies. On the other hand, the financial performance of healthcare mutual funds was not significantly affected by the COVID-19 pandemic crisis at the aggregate level. Therefore, adopting environmental practices in the healthcare sector did not result in a loss of investor wealth from 2016 to 2022.

These findings have practical implications for investors, managers, and policymakers. Investors concerned with environmental issues in the healthcare sector do not reduce their wealth by investing in mutual healthcare funds with high scores in the environmental dimensions and sub-dimensions. Healthcare mutual fund managers adopting environmental screens in their portfolio management strategies can comply with their fiduciary duties, reaching similar financial performance to the market in general. Policymakers should understand that mutual healthcare funds are effective instruments for providing financial resources to healthcare firms developing environmental innovation projects. The results of this study have theoretical implications for academia and researchers on this topic. They should consider the influence of the financial performance evaluation model on risk-adjusted returns.

This study has several limitations that should be addressed in future research. First, our environmental data were obtained from the Refinitiv EIKON database, which provides

up-to-date information from numerous publicly available information sources. However, other data providers, such as Morningstar, also provide environmental ratings, but only related to carbon emissions. Future research could re-examine the association between environmental and financial performance by selecting data from other ESG providers. Second, this study did not consider the weight of the portfolio invested in a specific country. Each country has a healthcare system and regulations. Future research could consider weight-based performance measures. Third, our sample was restricted to mutual healthcare funds invested in global geographical markets. Further analyses could include mutual healthcare funds investing in domestic markets and other financial products specializing in the healthcare sector, such as exchange-traded or pension funds. Fourth, our study did not examine the causal relationship between environmental and financial performance because we did not have longitudinal data for the environmental performance variables. Future research could examine the role of healthcare mutual funds as shareholders in improving the environmental performance of investee firms.

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