

The impact of ESG factors on Taiwan ETFs' performance



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ABSTRACT

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This study investigates the impact of ESG (Environmental, Social, and Governance) factors on the financial performance of Taiwan's index exchange-traded funds (ETFs). As ESG disclosure and assessment methodologies have become more comprehensive, and regulatory requirements have expanded, Taiwan's central role in global supply chains makes its ESG data particularly valuable for research and investment analysis. The study employs difference analysis, linear, and nonlinear regression models, analyzing monthly data from 2016 to 2023 and calculating the ESG scores adjusted for the weighted stock holdings of each fund. It explores the effect of ESG scores on fund flow, excess returns, CAPM alpha, and Sharpe ratio. The main empirical findings are as follows. First, ESG-themed funds attract significantly more capital flow than non-ESG funds, indicating market recognition of sustainable investment. However, no significant impact was found between ESG scores and fund flow. Second, although ESG funds attract more capital, they exhibit significantly lower excess returns and risk-adjusted returns. Environmental and social scores show a negative impact on excess returns and CAPM alpha in linear regression, suggesting that transition costs and investment restrictions in ESG-focused ETFs can constrain short-term performance and reduce diversification. Third, ESG and governance scores show nonlinear effects: while moderate improvements enhance excess returns, excessively high scores diminish these benefits. Lastly, when market attention is low, excess returns significantly improve, indicating that less attention to ESG-related topics reduces overpricing of ETFs.

Contribution/Originality: This study pioneers ETF-level ESG score calculation using TEJ firm data, examines its link to performance via various regression models, and finds nonlinear trade-offs at extreme scores. ESG-themed ETFs attract higher inflows but show no short-term performance advantage, implying a focus on long-term value over immediate gains.

1. INTRODUCTION

ESG (Environmental, Social, and Governance) indicators were first proposed by the United Nations in the 2004 WHO CARES WINS report, which argued that ESG indicators should be included as a benchmark for business operations. Climate change and environmental degradation have prompted governments around the world to prioritize climate risk management, and international and domestic policies are increasingly emphasizing ESG disclosure and sustainability. In Taiwan, for example, the Taiwan Stock Exchange requires listed companies with a capitalization of NT\$2 billion or more to submit a sustainability report from 2023 onwards, encouraging companies

to consider their impact on the environment while pursuing profits, thereby promoting sustainable economic and social development.

As the global financial markets continue to evolve, the role of ESG factors in investment decisions is increasingly emphasized. Investors are increasingly concerned about corporate social responsibility and sustainable development, making ESG a key consideration in the selection of investment targets. Against this backdrop, corporate ESG efforts not only comply with regulations but also enhance brand value and attract investors and customers. Many companies have increased their ESG scores to gain market recognition, competitiveness, and market share, which has led to the rapid rise of ESG funds, index funds, and other related financial products, which have gained widespread attention in the market. This study focuses on the domestic investment in Exchange-Traded Funds (ETFs), which are financial products that combine the characteristics of stocks with those of traditional funds. The main feature of an ETF is that it tracks a specific index (such as a stock index, bond index, or commodity index) and is listed and traded on an exchange. The price of an ETF is highly correlated with the performance of the index it tracks, and investors can trade it just like a stock. ETFs were first introduced in the U.S. in 1993, when the first ETF product, the SPDR S&P 500 ETF (SPY), was designed to provide investors with a low-cost way of investing in the S&P 500 Index. Since then, ETFs have rapidly expanded to global markets and have become an important tool for asset management.

ETFs are designed to track the performance of a specific index and provide investors with the convenience of real-time buying and selling through their listing on an exchange. By combining the benefits of diversification, efficiency, and transparency, ETFs have attracted a large base of both individual and institutional investors. Their appeal lies in features such as the high transparency of their investment composition, which mirrors the underlying index and allows investors to view detailed holdings and daily net asset values (NAV) at any time and their relatively low cost, as passive management strategies generally keep annual operating and management fees below 0.5%. In addition, ETFs can be traded instantly like stocks, offering high liquidity, and they typically track diversified indexes, enabling investors to spread their risk at a lower cost. Covering a wide range of asset classes, including equities, bonds, commodities, and currencies, as well as thematic areas such as ESG, artificial intelligence, and blockchain, ETFs can be tailored to suit a variety of investment goals.

However, despite these advantages, the risks associated with ETF investments should not be overlooked. Like other market-traded assets, ETFs are subject to market risk, with prices influenced by economic, political, monetary, and legal factors, potentially leading to losses from market fluctuations. While many ETFs achieve diversification by holding multiple securities, some focus on specific industries, stocks, or commodities, which can heighten concentration risk. Liquidity risk may arise if liquidity providers fail to maintain adequate quote services, making it difficult for investors to buy or sell at the desired time. Furthermore, ETFs can trade at prices above or below their NAV, creating premium or discount risks, an issue that can be more pronounced in funds tracking foreign assets due to differences in trading hours. In certain cases, small fund sizes or low unit values may prompt issuers to terminate listings, forcing investors to bear the risks involved in liquidation. For ETFs that use futures contracts, switching from one contract to another can incur additional costs, especially when forward futures prices exceed those of near-month contracts, which may erode returns.

As flexible, low-cost instruments with wide applicability, ETFs continue to play an important role in modern investment portfolios. Yet, understanding both their benefits and their risks remains essential for informed decision-making.

Taiwan's ETF market has developed rapidly since the launch of the first Yuanta Taiwan Premier 50 ETF (ticker: 0050) in 2003. As of 2023, the number of ETFs in Taiwan exceeds 220, covering equities, bonds, commodities, and thematic ETFs, with ETFs accounting for 22% of the fund universe compared to other funds (see Table 1).

Table 1. Statistics of ETF fund files, 2016-2023.

Year	ETF number of funds	Number of funds	ETFs as a percentage of fund size
2016	56	725	7.72%
2017	92	800	11.50%
2018	130	859	15.13%
2019	208	978	21.27%
2020	198	980	20.20%
2021	206	995	20.70%
2022	217	1,016	21.36%
2023	227	1,032	22.00%

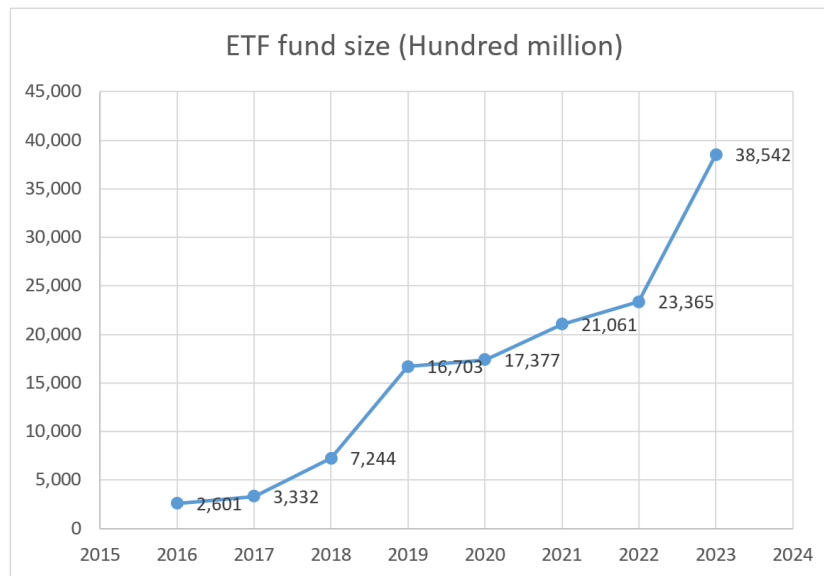


Figure 1. ETF fund size, 2016-2023.

As shown in Figure 1, the fund size of ETFs has also reached a record high year after year, and according to Table 2, the proportion of ETFs in the fund size of the ROC (Republic of China) Securities Investment Trust and Consultants Association will be as high as 57.22% in 2023.

Table 2. ETF fund size statistics, 2016-2023.

Year	ETF fund size (Hundred million)	Fund size (Hundred million)	ETFs as a percentage of fund size
2016	2,601	21,235	12.25%
2017	3,332	23,185	14.37%
2018	7,244	25,719	28.17%
2019	16,703	40,046	41.71%
2020	17,377	45,232	38.42%
2021	21,061	49,552	42.50%
2022	23,365	48,568	48.11%
2023	38,542	67,362	57.22%

According to the Financial Statistics Circular (No. 21) of the Census and Statistics Department, the ETF transaction amount from January to September 2024 has already surpassed the total annual amount of any previous year. In 2024, with the Taiwan stock market standing at the 20,000-point mark and the popularity of high dividend ETFs, the transaction amount from January to September 2024 reached NT\$7.4 trillion (accounting for 7.6% of the total), representing a 1.3-fold increase compared to the same period of the previous year. The securities transaction amount amounted to NT\$4.9 billion by September 2024, accounting for 2.2% of the total. The Securities and Futures Commission (SFC) levy amounted to NT\$4.9 billion, also accounting for 2.2% of the total, indicating that investors have been very fond of ETFs in recent years. In the Financial Statistics Circular (No. 21) issued by the

Census and Statistics Department, the Ministry of Finance (MOF) observed the trading situation of various types of ETFs in January-September 2024. The turnover of domestic constituent stocks investing in domestic stocks was the highest at 3.2 trillion dollars, accounting for 43.1% of the total turnover, which was 1.6 times higher than the same period in 2023. The turnover of bond and fixed-income stocks was the second largest, accounting for 34.5% of the total turnover, which was 2.3 times higher than that of the same period in 2023. The performance of Taiwan stocks attracted many investors. The outstanding performance of Taiwan stocks in 2023 drew significant investor interest. Meanwhile, the market expects that the U.S. Federal Reserve may start to cut interest rates in the second half of the year, which also boosted the demand for bond ETFs mainly targeting U.S. public and corporate bonds. In terms of tax revenue, domestic constituent ETFs contributed the highest amount of SFC tax, amounting to \$3.19 billion, which accounts for more than 65% of the total. Bond and fixed-income ETFs contributed less than 1% of the total tax revenue, amounting to only \$0.04 billion, due to the government's temporary exemption of SFC tax for the period from 2017 to 2026 to promote the development of such ETFs.

The popularity of ETFs in Taiwan has increased dramatically in recent years due to their high transparency and low-cost features. Figure 2 shows that the number of beneficiaries has reached a record high year after year, and they have become an important tool for many investors to make asset allocations, with ETFs accounting for 87.85% of beneficiaries in 2023 (see Table 3). The continuous growth in the number of beneficiaries in the ETF market reflects investors' recognition of the diversity and flexibility of ETF products. In addition, index equity funds are not affected by the performance of a single company, which can diversify the investment risk and is less burdensome for those who are new to investing or do not have time to study the financial market.

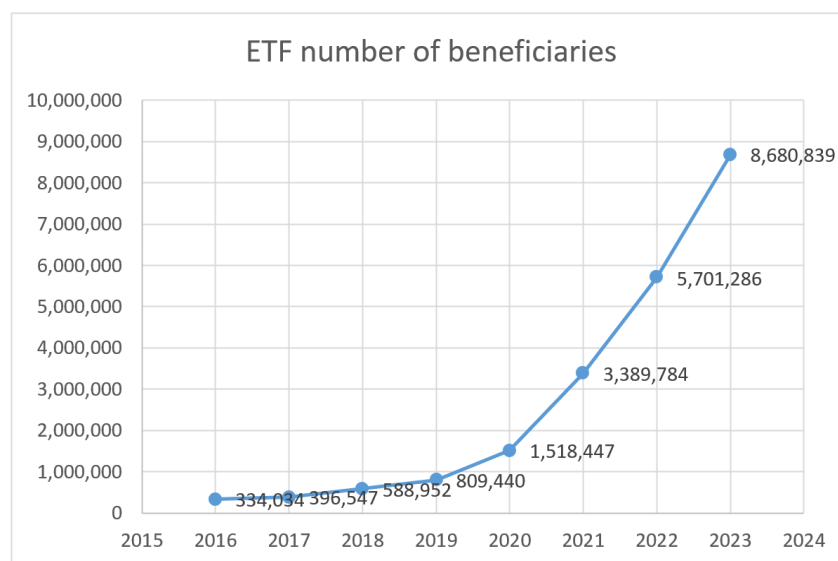


Figure 2. Number of ETF beneficiaries, 2016-2023.

Table 3. ETF Beneficiary Count Statistics, 2016-2023.

Year	ETF number of beneficiaries	Total number of beneficiaries	ETFs as a percentage of beneficiaries
2016	334,034	1,602,663	20.84%
2017	396,547	1,600,345	24.78%
2018	588,952	1,768,723	33.30%
2019	809,440	1,948,097	41.55%
2020	1,518,447	2,685,523	56.54%
2021	3,389,784	4,631,303	73.19%
2022	5,701,286	6,945,878	82.08%
2023	8,680,839	9,881,786	87.85%

The main objective of this study is to examine the actual impact of ESG factors on fund performance and to assess whether these factors can serve as a key reference for investors in formulating their investment strategies, as well as to promote the further development of ESG investment in the financial market. This study is expected to help encourage more investors to consider ESG factors, thereby promoting greater attention to social and environmental sustainability.

At the investment level, as investors emphasize sustainable development, ESG factors have gradually become an important basis for choosing investment targets. In this study, we analyze the possible heterogeneous impact on fund performance based on the three major ESG dimensions: environmental (E), social (S), and corporate governance (G). In addition, few studies have gone further by including specific indicators such as ESG negative event ratios, Google Trends scores, and weather indicators to examine the role of these variables in investment performance. This study not only focuses on the three main components of ESG scoring but also combines ESG negative event rates with market sentiment (Google Trends scores) and macroeconomic variables (weather indicators) to provide a more comprehensive analytical framework that highlights the importance of ESG factors and their related indicators on fund performance.

We contribute to the literature in several aspects. First, to the best of our knowledge, this study is the first to calculate ESG scores for exchange-traded funds (ETFs) using the comprehensive firm-level ESG ratings provided by the Taiwan Economic Journal (TEJ), and to examine how these fund-level ESG scores relate to ETF performance. Chang (2021) adopts the same approach to calculate ESG scores for mutual funds in the United States. While most existing literature focuses on ESG at the firm level (Kao, 2023) or compares performance and risk between ESG funds and non-ESG funds (Lin, 2023; Wei, 2021), relatively few studies have explored the effects of ESG scores at the ETF level. However, growing investor interest in ESG has led to a surge in the number of ESG-labeled ETFs actively traded in the market. As a result, understanding how ESG scores influence ETF performance has become an increasingly important topic in sustainable finance research.

Second, this study adopts multiple model specifications, including linear regression, nonlinear regression, and piecewise linear regression models to analyze the relationship between ESG scores and ETF performance (Chang, 2021). The linear regression results show no significant positive impact of ESG scores on short-term ETF performance. In contrast, nonlinear models reveal that excessively high ESG scores may negatively affect short-term performance, suggesting a potential trade-off when ESG is pursued to an extreme. Furthermore, the piecewise linear regression results indicate that less public attention to ESG, measured by search intensity, is positively associated with better short-term ETF performance.

Finally, this study compares ESG-themed ETFs with non-ESG ETFs. The results show that ESG-themed ETFs do not exhibit significantly different performance compared to other types of ETFs. This result differs from those reported in studies on the United States (Lin, 2023; Wei, 2021). However, ESG-themed funds experience significantly higher capital inflows, suggesting that they hold greater appeal to investors. Moreover, the lack of a significant positive impact of ESG scores on short-term ETF performance implies that ESG-oriented firms tend to focus on long-term value creation rather than short-term gains. Given the costs associated with ESG investing, such strategies may not immediately benefit short-term fund performance.

The structure of this paper is described as follows. The first section of this paper is an introduction, which describes the background, motivation, and purpose of the study, and outlines the overall structure of the study. Section 2 introduces the review and application of relevant domestic and overseas literature to provide a theoretical basis for the study. Section 3 describes the design and methodology of the study, including the flow and examination of the empirical research. Section 4 presents the empirical results and analyzes, compares, and discusses the results. Finally, section 5 summarizes the conclusions of the study and provides recommendations at two different levels, with specific suggestions and guidelines for regulators and investors.

2. LITERATURE REVIEW

2.1. ESG (*Environmental, Social and Corporate Governance*)

ESG is an acronym for “Environmental,” “Social,” and “Governance.” The concept of ESG was first proposed by the United Nations in 2004 in the WHO CARES WINS report, which recommended that participants in global capital markets incorporate ESG factors into investment analysis and corporate governance to promote long-term stability and sustainable development. The report recommended that global capital market participants incorporate ESG factors into their investment analysis and corporate governance to promote long-term stability and sustainable development of the market. Since then, ESG has become one of the most important tools for promoting Sustainable Development Goals (SDGs) in the international arena and has been gradually integrated into policies and regulations, as well as corporate management and investment strategies.

The Environment dimension focuses on a company’s impact on the natural environment, including resource use, carbon emissions, climate change adaptation measures, and ecological protection etc. In the face of increasingly stringent climate-related policies, good environmental performance can reduce environmental risks. For example, a company’s performance in reducing its carbon footprint, using renewable energy, and minimizing pollution will have a direct impact on its environmental score.

The social dimension involves how a company treats its employees, supply chain, community, and the impact of its products and services, such as labor rights protection, diversity and inclusion, consumer protection, and social welfare participation. Good social performance helps to enhance corporate reputation, attract loyal customers, and maintain stable employee teams. Companies that support labor equality, ensure product safety, and promote community well-being usually have better social ratings.

The Corporate Governance focuses on the internal management of an enterprise, including the protection of shareholders’ rights and interests, the structure of the board of directors, operational transparency, and anti-corruption measures. Sound corporate governance is the cornerstone of a company’s long-term stable operation, affecting the efficiency of capital allocation and investor confidence. Companies with a strong governance structure are more capable of maintaining stability in the face of market challenges.

ESG is not only an indicator of internal corporate management but has also become an important reference for investors and consumers to assess asset risk and value. Recent literature underscores the growing importance of Environmental, Social, and Governance (ESG) factors in shaping corporate behavior, investor decision-making, market dynamics, and regulatory frameworks. Research has increasingly focused on the financial and strategic implications of ESG engagement, disclosure, and perception at both the firm and systemic levels.

2.2. *ESG Engagement, Disclosure, and Regulatory Impact*

Engagement on ESG issues has been shown to reduce firm-level risks and enhance shareholder value. Hoepner, Oikonomou, Sautner, Starks, and Zhou (2024) demonstrate that active ESG engagement, particularly on environmental concerns such as climate change, can reduce firms’ downside risks and improve financial performance. Their findings also emphasize the strategic value of investor-led engagement and the regulatory implications of ESG practices. Similarly, Krueger, Sautner, Tang, and Zhong (2024) provide evidence that mandatory ESG disclosure regulations significantly improve stock liquidity, with the effect being most pronounced under government enforcement and full compliance regimes. Their work highlights not only the impact of ESG disclosure on firm performance but also the role of formal and informal institutions in shaping cross-country variations in ESG implementation. At the national level, regulatory action also plays a pivotal role in ESG outcomes. Niu (2024) shows that government environmental protection expenditures are strongly and positively associated with national ESG performance. By using data from 27 countries, the study confirms that such spending improves environmental, social, and governance dimensions while passing multiple robustness tests, reinforcing the role of public investment in enhancing sustainable development metrics.

2.3. ESG Ratings, Uncertainty, and Market Behavior

Another critical dimension in the ESG discourse concerns ESG rating uncertainty and the divergence among ESG evaluators. Avramov, Cheng, Lioui, and Tarelli (2022) show that the standard deviation across ESG rating agencies serves as a proxy for investor uncertainty. This divergence leads to increased market risk premiums, lower demand for green stocks, and higher costs of capital for firms, especially in cases of high ESG rating disagreement. Complementary findings by Brandon, Krueger, and Schmidt (2021) suggest that stock returns are positively associated with ESG rating disagreement, particularly regarding environmental factors, implying a risk premium for firms operating under ESG-related uncertainty.

Public interest in ESG also plays a role in market pricing. Lu (2024) demonstrates that Google search trends related to sustainability significantly affect the stock prices of ESG-themed firms, though these effects vary across industries. This reflects growing investor sensitivity to public discourse and ESG-related sentiment as market signals. In contrast, Walker, Fernandes, and Karami (2024) explore the dynamics of ESG performance during the COVID-19 crisis and find that ESG factors had a limited influence on short-term investor behavior. Despite significant market reactions to pandemic-related events, firms with higher ESG ratings did not demonstrate superior stock performance. This suggests that during periods of heightened uncertainty, investors may prioritize short-term resilience over ESG credentials, and that ESG strategies must be integrated with broader risk management approaches.

2.4. ESG and Consumer Behavior

Beyond financial markets, ESG considerations are also shaping consumer perceptions and firm-level marketing strategies. Lin (2024) finds that consumer ESG awareness significantly enhances a company's brand image and strengthens customer trust, which in turn improves perceptions of the firm's products and services. The study highlights the role of consistent sustainability-driven branding as an effective strategy for long-term brand equity. These findings align with broader marketing and strategic management literature, which increasingly emphasizes the reputational benefits of ESG.

2.5. ESG and Sovereign Finance

On the sovereign level, ESG performance also carries financial consequences. Crifo, Diaye, and Oueghlissi (2017) demonstrate that countries with higher ESG ratings tend to face lower sovereign borrowing costs, as reflected in reduced government bond spreads. This suggests that ESG considerations extend beyond corporate boundaries to influence the pricing of sovereign debt and the perceived risk of national governments.

Collectively, these studies reveal that ESG considerations are deeply embedded in contemporary financial systems, regulatory frameworks, and consumer markets. ESG engagement and disclosure can yield financial and reputational benefits, while uncertainty in ESG ratings introduces risk premiums and investor hesitation. Moreover, ESG perceptions, whether by investors, consumers, or governments, shape both micro- and macroeconomic outcomes. However, the efficacy of ESG strategies is context-dependent, with their short-term impact often limited during periods of crisis or when clouded by inconsistent ratings. Thus, future ESG initiatives must balance long-term sustainability goals with clear, standardized disclosures and adaptive risk management strategies to ensure credibility and effectiveness across stakeholder groups.

With the challenges of climate change and increased awareness of social responsibility, ESG has gradually become an important indicator that cannot be ignored in the investment market. In the future, the standardization and transparency of ESG-related data are expected to further improve, and corporate investment in ESG will become a key factor in enhancing competitiveness and attracting investment.

2.6. Literature on ESG Funds and Fund Performance

Taiwan's regulations on ESG funds focus on ensuring transparency of information and protecting investor rights. Whether it is the issuance of domestic ESG-themed funds or the fundraising and sales of overseas ESG funds, all must comply with the relevant regulations established by the Financial Supervisory Commission (FSC). According to the FSC's Circular No. 1100362463 dated July 2, 2021, and Order No. 1100365536 dated January 11, 2022, all ESG-themed fund products must clearly state the content and implementation methods of the ESG theme in their prospectuses and investor information documents. Additionally, domestic mutual fund companies and foreign fund agents must ensure the accuracy of fund information. If any false or erroneous information is found in public documents, the relevant legal liabilities will be borne by these institutions. The FSC further requires that, to avoid misleading investors, any advertisements or promotions must not portray the FSC's approval or registration of a fund as a guarantee of its performance. These regulations aim to promote the healthy development of the ESG fund market and enhance investors' risk awareness and decision-making transparency. The FSC's regulations not only emphasize the completeness and reliability of ESG fund information but also require fund managers to uphold integrity in information disclosure and advertising to ensure investors can make decisions based on comprehensive and accurate information.

According to statistics from the Taiwan Securities Investment Trust and Advisory Association's ESG Sustainable Development Transformation Zone for the investment trust and advisory industry, as of the end of October 2024, the scale of domestic ESG funds was approximately NT\$793.6 billion. When compared to overseas ESG funds, domestic ESG funds in Taiwan lead in terms of scale and trading activity, reflecting Taiwanese investors' preference and demand for local sustainable investment products.

Among ESG funds, ESG ETFs have attracted significant market attention. ESG ETFs are funds related to environmental, social, and corporate governance themes (ESG funds). In accordance with the "Review and Supervision Principles for Information Disclosure Matters of ESG-Related Thematic Mutual Funds" issued by the Financial Supervisory Commission in July 2021, they are listed in the Environmental, Social, and Corporate Governance Fund Zone (ESG Fund Zone). As of the end of October 2024, there were a total of 10 listed ETFs and a total of seven OTC-listed ETFs in this section, with a combined asset size of NT\$482.8 billion and NT\$279.7 billion, respectively.

As ESG factors gain increasing attention from investors, they are playing an increasingly important role in investment decisions. Numerous studies have conducted in-depth analyses of the impact of ESG factors on fund performance.

A growing body of empirical research has explored the relationship between ESG scores and fund performance, revealing nuanced and sometimes conflicting outcomes. Several studies find that ESG funds often outperform their non-ESG counterparts in terms of returns. For example, [Lin \(2023\)](#) and [Wei \(2021\)](#) both reported superior performance by ESG funds compared to non-ESG funds in the United States, with Lin noting that ESG funds also received higher ESG scores. Similarly, [Chang \(2021\)](#), who computed U.S. fund-level ESG scores by aggregating stock-level data, found that ESG scores were negatively correlated with both fund flows and returns. Interestingly, this suggests that investors may favor funds with lower ESG scores, potentially due to their higher short-term return potential. Piecewise regression results further support that this negative relationship is more pronounced among funds with lower ESG scores.

This paradoxical effect is echoed in several other studies that highlight potential trade-offs between ESG ratings and financial performance. For instance, [Papathanasiou and Koutsokostas \(2024\)](#) found that low-rated ESG equity funds in Europe outperformed their higher-rated counterparts in the short term and exhibited stronger persistence in performance. Notably, higher-rated ESG funds tended to have higher expense ratios, which may erode net returns. The study also found that investor behavior shifted during the COVID-19 pandemic, with investors withdrawing from low-rated ESG funds due to increased risk aversion despite their previous superior

performance. Similarly, [Sim and Kim \(2022\)](#) documented that while ESG funds in Korea held higher ESG scores than traditional funds, these scores were negatively correlated with future risk-adjusted performance. Moreover, funds with higher ESG ratings demonstrated lower sensitivity to capital flows, implying reduced responsiveness to market signals.

On the other hand, some research highlights the risk-reduction benefits associated with ESG investing. [Lu \(2021\)](#), for instance, categorized funds based on their holdings of ESG component stocks and found that those with higher ESG stock exposure did not necessarily perform better in terms of returns, but they achieved lower total and systematic risk. This suggests that while ESG may not guarantee higher returns, it may contribute to more stable fund performance.

When comparing different types of funds, [Chiang \(2022\)](#) categorized equity, bond, and ETF funds into ESG and non-ESG categories. While ESG funds generally underperformed in terms of Sharpe and Jensen ratios, paired comparisons revealed that stock- and ETF-based ESG funds performed better than their non-ESG counterparts, suggesting that fund type and structure may moderate the ESG-performance relationship.

In the context of the Taiwanese market, [Chu \(2023\)](#) analyzed 29 ETFs from 2020 to 2022 and found that ESG funds underperformed non-ESG funds based on the Treynor ratio. Additionally, the study identified expense ratios as a key determinant of fund returns, with higher fees negatively impacting performance. [Kao \(2023\)](#) extended this analysis to ESG component stocks in Taiwan and found that while these stocks underperformed in traditional financial metrics such as return on assets, net profit margin, and earnings per share, they nevertheless achieved higher net asset return rates compared to benchmark indices like the Taiwan 50 and the broader weighted index. This suggests that despite weaker accounting-based performance, ESG stocks were positively affirmed by the market, possibly due to investor preferences for sustainability.

Together, these studies indicate that the relationship between ESG scores and fund performance is complex and context-dependent. While ESG funds often appeal to investors and may provide risk-reduction benefits, high ESG ratings do not consistently translate into superior financial returns, particularly in the short term. Moreover, fund flows, expense ratios, market conditions, and investor sentiment all play mediating roles in shaping the ESG performance dynamic. From the above literature, it can also be observed that, after empirical testing of ESG factors under different conditions and investment decisions, there are no consistent results regarding performance and returns. These findings highlight the complexity of ESG factors in fund investment decisions and their potential impact on investor performance. We summarize prior findings and compare them with our study in the following [Table 4](#).

Table 4. Prior findings vs. our study.

Paper	Key findings	Our study
Chu (2023)	ESG funds underperformed non-ESG funds in Taiwan.	We examine ETFs rather than mutual funds. In addition, we investigate the relationship between the ESG score of ETFs and ETF performance.
Lin (2023) and Wei (2021)	ESG funds outperformed non-ESG funds in the United States.	Our study focuses on ETFs in Taiwan.
Kao (2023)	ESG component stocks in Taiwan underperform in return on assets, net profit margin, and earnings per share.	We study the performance of ETFs instead of individual component stocks.
Lu (2021)	Funds with higher ESG stock exposure did not necessarily achieve higher returns but experienced lower total and systematic risk.	We find that ESG scores of ETFs are negatively associated with ETF returns.
Chiang (2022)	While ESG funds generally underperformed in terms of Sharpe and Jensen ratios, paired comparisons revealed that stock- and ETF-based ESG funds performed better than non-ESG counterparts.	We investigate the effect of ETF ESG scores on ETF performance rather than merely comparing ESG vs. non-ESG funds.

Paper	Key findings	Our study
Sim and Kim (2022)	ESG funds in Korea held higher ESG scores than traditional funds, but these scores were negatively correlated with future risk-adjusted performance.	Our findings similarly show a negative correlation between ESG scores and ETF performance in Taiwan.
Chang (2021)	U.S. fund-level ESG scores were negatively correlated with both fund flows and returns, with the effect more pronounced among funds with lower ESG scores.	We observe a negative association between Taiwan ETFs' ESG scores and returns, with the effect more pronounced among ETFs with high ESG scores in nonlinear regression models.

3. RESEARCH DESIGN AND METHODS

3.1. Research Sample

The research sample for this study consists of funds classified as “AH11 Domestic Investment Index Stock-Type” by the Taiwan Securities Investment Trust and Advisory Association. A total of 52 listed index stock funds were selected, including 10 ESG funds listed in the ESG fund section and 42 non-ESG funds. The sample period spans from January 1, 2016, to December 31, 2023, covering eight years of data, with monthly data used for analysis in this study.

3.2. Data Sources

Quarterly fund holdings data is sourced from the Public Information Observation Station. Fund basic information, fund expense ratios, fund total net asset value (TNA), and composite economic policy signal scores are sourced from the Taiwan Economic Journal (TEJ) database. Data required for calculating fund ESG scores, fund flows, excess returns, CAPM Alpha, Sharpe ratio, and ESG negative event ratio calculations are also sourced from the TEJ database. Google Trends scores are sourced from Google Search Trends.

3.3. TEJ “TESG Sustainable Development Index”

The TEJ “TESG Sustainable Development Index” is an ESG rating system specifically designed for Taiwanese enterprises. The index is constructed using quantitative variables developed under the official authorization of the Sustainability Accounting Standards Board (SASB), and it also incorporates evaluations based on the Global Reporting Initiative (GRI) standards to assess corporate sustainability disclosures. Organized under the three core pillars of ESG, the index comprises 16 key topics and utilizes over 70 variables.

The rating scale consists of seven levels, ranging from A+ to C-, based solely on quantitative data. This structure enables users to quickly assess a company's ESG risks and performance by observing changes in its rating level. The TESG index offers several key advantages. It provides a comprehensive and in-depth ESG assessment, covering all publicly listed, OTC, and emerging board companies in Taiwan, including those without CSR or sustainability reports. Through a curated summary of ESG-related events, users can monitor daily developments and assess their impact on corporate ESG performance. In addition, the index integrates the PCAF (Partnership for Carbon Accounting Financials) methodology to estimate and manage carbon emissions effectively, addressing both transition and physical risks.

The TESG index is supported by an expert research team closely aligned with global standards. As the first SASB-licensed ESG rating system in Taiwan, it meets rigorous review requirements to ensure consistency with international ESG practices. By combining advanced quantitative analytics with global ESG frameworks, TESG delivers ratings that reflect both international trends and best practices. The R&D team includes certified professionals in carbon management, corporate sustainability, and sustainable carbon strategies, with more than two decades of experience in corporate governance and ESG research.

This expertise is further reinforced by a solid foundation in ESG research. The platform hosts a robust database encompassing more than 40 thematic areas and over 600 data items, offering a rich resource for in-depth

analysis. Data collection, cleaning, and validation processes are conducted with precision to ensure completeness and comparability. Moreover, the index provides valuable insights into corporate governance structures, enabling users to better understand executive decision-making processes and overall governance quality.

3.4. Definition of Research Variables

3.4.1. Dependent Variables

1. Fund Flow

Fund flow refers to the changes in the inflow and outflow of funds for each fund within a certain period of time. It is typically used to assess investor demand for funds. The following formula can help understand the inflow and outflow of funds, thereby analyzing market confidence in the fund. The calculation formula is as follows:

$$Flow = TNA_t - TNA_{t-1} \times (1 + return_t) \quad (1)$$

Among these, TNA_t represents the current net asset value of the fund, TNA_{t-1} represents the net asset value of the fund in the previous period, and $return_t$ represents the current rate of return. Changes in fund flows can reveal investor sentiment and market trends, serving as an important basis for fund managers to evaluate fund performance and adjust investment strategies. Positive flows indicate capital inflows, reflecting increased investor confidence in the fund, while negative flows may indicate weakened confidence or unfavorable market sentiment toward the fund.

2. Excess Return Rate (Mretrf)

The excess return rate refers to the difference between the fund's actual return rate and the risk-free rate, used to measure the quality of the fund's performance. By calculating the excess return rate, investors can assess the fund's actual performance after adjusting for risk. The calculation formula is:

$$Mretrf = fund\ return_t - risk\ free\ rate_t \quad (2)$$

Where fund $return_t$ represents the fund's return rate for the period, and $risk\ free\ rate_t$ is the risk-free rate for the period, with the risk-free rate using the one-year deposit interest rate of the First Commercial Bank as the reference rate. Excess return not only reflects the fund's true performance but also helps investors determine whether it is worth investing in the fund, especially in terms of risk management. By using excess return, investors can better compare the performance of different funds and make more informed investment decisions. A positive excess return indicates that the fund's return exceeds the risk-free rate, demonstrating its superior performance relative to the market, while a negative excess return may indicate inadequate risk management or poor fund performance.

3. CAPM Alpha

CAPM Alpha is an important indicator of fund performance, reflecting the fund's performance relative to expected returns. It calculates the difference between the fund's actual returns and the expected returns based on the Capital Asset Pricing Model (CAPM). The formula for calculating CAPM Alpha is:

$$CAPM\ Alpha = fund\ return_t - \left[\frac{risk\ free\ rate_t + \beta_{t-11 \sim t}}{\times (market\ return_t - risk\ free\ rate_t)} \right] \quad (3)$$

Where β is obtained from the Taiwan Economic Journal (TEJ) database and measures the extent to which the fund's return fluctuates relative to the market return, calculated using the fund's monthly ROI over the past 12 months and the market's monthly ROI (Y9999 weighted index). This formula is used to assess whether the fund has generated excess returns after accounting for market risk. A positive CAPM Alpha indicates that the fund's performance exceeds expectations, while a negative value indicates underperformance. This metric is crucial for evaluating fund managers' performance and helps investors select funds with good risk-adjusted performance.

4. Sharpe Ratio

The Sharpe Ratio is an important metric for assessing a fund's risk-adjusted returns, used to compare the performance of different investments and help investors understand whether the additional returns obtained are worthwhile given the specific risks involved. In calculating the Sharpe Ratio, the risk-free rate uses the one-year deposit rate of the First Commercial Bank as the reference rate. The formula is:

$$\text{Sharpe ratio} = \frac{\bar{R} - \bar{R}_f}{\sigma_i} \quad (4)$$

Where $\bar{R}$ represents the average monthly return of the fund over the past 12 months, $\bar{R}_f$ represents the average monthly risk-free rate over the past 12 months, and σ_i represents the standard deviation of the monthly returns over the past 12 months.

The level of the Sharpe ratio indicates the additional return per unit of risk. A positive Sharpe ratio indicates that the investment return exceeds the risk-free rate, while a negative Sharpe ratio indicates that the investment return fails to reach the risk-free rate level. This indicator provides important guidance for investors in selecting investment portfolios after risk adjustment.

3.4.2. Independent Variables

1. ESG Score

We follow MSCI ESG Fund ratings methodology to calculate ETF ESG scores. Each holding in the fund is weighted according to its weighting. Holdings without ESG scores (missing values) are excluded, and the remaining holdings are reweighted to 100%. Next, each holding with an ESG score is multiplied by its corresponding adjusted weighting, and the results are summed to obtain the fund's weighted average ESG score.

2. Environmental Score (Escore)/Social Score (Sscore)/Governance Score (Gscore)

Following the same calculation method as for the ESG score, the fund's holdings are weighted by their respective weights. After excluding holdings without E, S, or G scores, the remaining holdings' weights are adjusted to 100%. Next, each holding with an E, S, or G score is multiplied by its adjusted weight, and the results are summed to obtain the fund's weighted average E, S, and G scores.

3.4.3. Control Variables

1. Fund Manager Fee Rate (Management Fee, MF)

This study uses the management fee rate paid by the fund to the fund management company as a control variable. This fee is established to compensate fund managers for their professional services in investment, operations, and management. It is important to note that investors do not need to pay this fee separately, as it is automatically deducted daily from the fund's assets and is typically disclosed in the fund's prospectus. Different types of funds have different management fees. For example, domestic equity funds generally have management fees ranging from 0.70% to 1.60%, while funds investing in overseas markets typically have higher management fees, ranging from 1.50% to 1.80%; domestic bond funds have management fees of approximately 0.25% to 0.60%; currently, the upper limit for management fees of domestic hybrid funds is 0.50%. The management fee rate is calculated using the following formula:

$$MF = \text{Management Fee} / \text{Fund Net Asset Value} \times 100\% \quad (5)$$

2. Total Fund Expense Ratio (TF)

The total fund expense ratio is an indicator of the operational costs of an investment fund. The calculation formula for the total fund expense ratio is as follows:

$$TF = (\text{Management Fee} + \text{Custody Fee} + \text{Guarantee Fee} + \text{Total Other Fees} / \text{Fund Net Asset Value}) \times 100\% \quad (6)$$

3. Total Fund Net Asset Value (TNA)

The Total Net Asset (TNA) provided by the Taiwan Economic Journal (TEJ) database is used as the variable. The TNA is expressed in New Taiwan Dollars (NTD) in millions, reflecting the scale of assets managed by the fund. This data not only reveals the fund's financial health but also reflects investors' trust in the fund and changes in market demand.

4. ESG Negative Event Ratio (NER)

This ratio is used to assess the extent to which negative events have impacted the fund's constituent stocks over a specific period, thereby further analyzing the potential impact of these negative events on the fund's performance. Using data from the Taiwan Economic Journal (TEJ) database, we compiled ESG-related negative news events involving publicly listed companies in Taiwan, identified negative news events related to the fund, and calculated the negative event ratio using the following formula:

$$NER = \text{Number of Negative Events} / \text{Number of Constituent Stocks} \quad (7)$$

The number of negative events refers to the total number of negative events occurring in all constituent stocks of the fund during a specific period, while the number of constituent stocks refers to the total number of constituent stocks held by the fund during a specific period.

5. Google Trends Score (GTS)

The Google Trends Score is used as an indicator of search popularity to analyze changes in public interest in sustainability issues. This indicator reflects changes in the search frequency of specific keywords within a selected region and time frame. The keyword selected for this study is "ESG." The keyword value ranges from 0 to 100, with 100 indicating the highest search heat for the keyword at a specific point in time. If the score at a certain point in time is 50, it indicates that the search heat for the keyword is only half of the peak value, while a score of 0 indicates insufficient search data for the keyword, making effective analysis impossible.

6. Monitoring Indicators Score (MIS)

The Monitoring Indicators Score is used as an indicator to measure the economic environment. This indicator integrates multiple economic data points, including production, consumption, and investment, effectively reflecting changes in the overall economic situation and influencing capital flows in the capital market.

3.5. Research Model

This study adopted the following model to examine whether ESG factors have an impact on fund financial performance. Based on the recommendations of Chang (2021), ESG scores were subdivided into three categories: environmental (E), social (S), and corporate governance (G) scores to analyze their impact on fund performance. The ESG score variable is lagged by three months to align with the frequency of fund flow data updates, and lagged by one year to reflect the calculation periods for fund returns, CAPM Alpha, Sharpe ratio, and excess return rate (Mretrf). In addition, the model incorporates the proportion of ESG negative events, Google Trends scores, and a composite economic policy signal score. By including Google Trends scores, the model captures public attention to ESG-related issues, thereby exploring their impact on fund inflows and financial performance, and further understanding the relationship between market sentiment and ESG investing. All models also account for fixed effects of time and fund management style.

The linear regression model is as follows:

$$Flow_t = \alpha + \beta_1 Flow_{t-1} + \beta_2 Score_{t-3} + \beta_3 TF_{t-1} + \beta_4 MF_{t-1} + \beta_5 Mretrf_{t-1} + \beta_6 TNA_{t-1} + \beta_7 NER_{t-1} + \beta_8 GTS_{t-1} + \beta_9 MIS_{t-1} + \text{Time/Fund Style Management Fixed Effect} + \epsilon_t \quad (8)$$

$$Mretrf_t = \alpha + \beta_1 Mretrf_{t-1} + \beta_2 Score_{t-12} + \beta_3 TF_{t-1} + \beta_4 MF_{t-1} + \beta_5 TNA_{t-1} + \beta_6 NER_{t-1} + \beta_7 GTS_{t-1} + \beta_8 MIS_{t-1} + \text{Time/Fund Style Management Fixed Effect} + \epsilon_t \quad (9)$$

$$CAPM\ Alpha_t = \alpha + \beta_1 CAPM\ Alpha_{t-1} + \beta_2 Score_{t-12} + \beta_3 TF_{t-1} + \beta_4 MF_{t-1} + \beta_5 TNA_{t-1} + \beta_6 NER_{t-1} + \beta_7 GTS_{t-1} + \beta_8 MIS_{t-1} + \text{Time/Fund Style Management Fixed Effect} + \epsilon_t \quad (10)$$

$$\text{Sharpe ratio}_t = \alpha + \beta_1 \text{Sharpe ratio}_{t-1} + \beta_2 \text{Score}_{t-12} + \beta_3 \text{TF}_{t-1} + \beta_4 \text{MF}_{t-1} + \beta_5 \text{TNA}_{t-1} + \beta_6 \text{NER}_{t-1} + \beta_7 \text{GTS}_{t-1} + \beta_8 \text{MIS}_{t-1} + \text{Time/Fund Style Management Fixed Effect} + \epsilon_t \quad (11)$$

The linear regression models that break down the ESG score into three scores for environment (E), society (S), and corporate governance (G) is to replace $\beta_2 \text{Score}$ with $\beta_2 \text{Escore}$, $\beta_2 \text{Sscore}$, and $\beta_2 \text{Gscore}$ in above regressions. In addition, the nonlinear relationship between ESG scores and fund financial performance was also considered. Therefore, the square term of the score was added to the regression model, which is to replace $\beta_2 \text{Score}$ with $\beta_2 \text{Score}$ and $\beta_3 \text{Score}^2$ in above regressions. Nonlinear regression models for break-down ESG scores are similar. In addition, to examine the impact of fund financial performance on changes in Google Trends scores (GTS), this study selected a model similar to the piecewise linear regression model used by Sirri and Tufano (1998). The sample was ranked by percentile based on the fund's Google Trends score (GTS_{t-1}) from the previous period and divided into two groups: low and high GTS (rank).

$$R2 = \text{Min}(\text{Rank}, 0.5).$$

$$R1 = \text{Min}(\text{Rank} - R2, 0.5).$$

Rank is the ranking of funds based on their Google Trends scores (GTS_{t-1}) from the previous period, divided into the bottom 50% and top 50%. $\text{min}(\text{Rank}, 0.5)$ means that if a fund's rank is below 50% ($\text{Rank} < 0.5$), $R2$ equals the fund's rank; if the fund's rank is above 50% ($\text{Rank} \geq 0.5$), $R2$ is fixed at 0.5. $\text{min}(\text{Rank} - R2, 0.5)$ represents the relative ranking of the remaining funds after excluding the bottom 50% ($R2$), with these funds' rankings starting from $\text{Rank} - R2$ and restricted to within 50% to prevent rankings exceeding 50%.

All models account for fixed effects of time and fund management style. The piecewise linear regression model is as follows:

$$\text{Flow}_t = \alpha + \beta_1 R1_{t-1} + \beta_2 R2_{t-1} + \beta_3 \text{Flow}_{t-1} + \beta_4 \text{Score}_{t-3} + \beta_5 \text{TF}_{t-1} + \beta_6 \text{MF}_{t-1} + \beta_7 \text{Mretrf}_{t-1} + \beta_8 \text{TNA}_{t-1} + \beta_9 \text{NER}_{t-1} + \beta_{10} \text{MIS}_{t-1} + \text{Time/Fund Style Management Fixed Effect} + \epsilon_t \quad (12)$$

$$\text{Mretrf}_t = \alpha + \beta_1 R1_{t-1} + \beta_2 R2_{t-1} + \beta_3 \text{Mretrf}_{t-1} + \beta_4 \text{Score}_{t-12} + \beta_5 \text{TF}_{t-1} + \beta_6 \text{MF}_{t-1} + \beta_7 \text{TNA}_{t-1} + \beta_8 \text{NER}_{t-1} + \beta_9 \text{MIS}_{t-1} + \text{Time/Fund Style Management Fixed Effect} + \epsilon_t \quad (13)$$

$$\text{CAPM Alpha}_t = \alpha + \beta_1 R1_{t-1} + \beta_2 R2_{t-1} + \beta_3 \text{CAPM Alpha}_{t-1} + \beta_4 \text{Score}_{t-12} + \beta_5 \text{TF}_{t-1} + \beta_6 \text{MF}_{t-1} + \beta_7 \text{TNA}_{t-1} + \beta_8 \text{NER}_{t-1} + \beta_9 \text{MIS}_{t-1} + \text{Time/Fund Style Management Fixed Effect} + \epsilon_t \quad (14)$$

$$\text{Sharpe ratio}_t = \alpha + \beta_1 R1_{t-1} + \beta_2 R2_{t-1} + \beta_3 \text{Sharpe ratio}_{t-1} + \beta_4 \text{Score}_{t-12} + \beta_5 \text{TF}_{t-1} + \beta_6 \text{MF}_{t-1} + \beta_7 \text{TNA}_{t-1} + \beta_8 \text{NER}_{t-1} + \beta_9 \text{MIS}_{t-1} + \text{Time/Fund Style Management Fixed Effect} + \epsilon_t \quad (15)$$

4. EMPIRICAL RESULTS

4.1. Descriptive Statistics of Variables

The preliminary analysis of this study employs descriptive statistics to understand the basic distribution of the sample across various variables.

Table 5 presents the descriptive statistical results for each variable. The fund flow and total net asset value of funds exhibit significant variability, indicating that some funds in the sample attract substantial capital inflows, while others may face capital outflows.

The results for excess return and CAPM Alpha indicate that most funds generated negative returns, while a few funds performed exceptionally well. ESG scores indicate significant differences in fund performance across environmental, social, and governance dimensions, with social scores standing out.

Google Trends scores exhibit substantial volatility, which may impact fund returns and risk-adjusted returns. The descriptive statistical data provided in Table 4 lay the groundwork for subsequent regression analysis and further in-depth research.

Table 5. Descriptive statistics results for variables.

Variables	N	Mean	Std.	Min.	Max.
Flow (Million)	2354	318.424	3756.524	-54648.377	74683.066
Mretrf(%)	2370	-1.107	0.276	-1.681	-0.503
CAPM Alpha(%)	2008	0.361	2.263	-11.301	18.939
Sharpe ratio(%)	2008	0.237	0.333	-0.618	1.115
Score	2404	67.462	4.646	55.829	77.862
Escore	2404	68.621	6.268	55.123	80.747
Sscore	2404	72.454	5.901	56.541	84.693
Gscore	2404	63.271	3.902	52.140	72.892
TF(%)	2404	0.044	0.022	0.002	0.257
MF(%)	2404	0.027	0.008	0.002	0.065
TNA(million)	2404	13405.176	39215.863	60.538	342035.289
NER(%)	2404	0.060	0.093	0	1.647
GTS	2404	37.203	34.195	0	100
MIS	2404	23.265	8.379	10	41

4.2. Correlation Analysis

This study employs Pearson's correlation analysis to examine the interrelationships among various variables. Based on the table data, a total of 14 variables were analyzed for correlation, including fund flow, excess return rate (Mretrf), CAPM Alpha, Sharpe ratio, and ESG scores (score, Escore, Sscore, Gscore) Table 6 shows the correlations between the variables, and several key findings are as follows.

First, the total net asset value (TNA) and fund manager fees (MF) have a significant impact on fund flows and returns, particularly the negative impact of manager fees on returns. Second, the ESG score (Score) and the three ESG component scores (Escore, Sscore, Gscore) have a significant negative impact on excess returns (Mretrf), indicating that higher scores may reduce fund returns. Finally, the impact of market attention (GTS) on fund performance is more complex; market attention to ESG issues may suppress a fund's excess returns, but it may have a slight positive impact on risk-adjusted returns.

Table 6. Pearson correlation analysis of each variable.

Variables	Flow	Mretrf	CAPM Alpha	Sharpe ratio	Score	Escore	Sscore	Gscore	TF	MF	TNA	NER	GTS	MIS
Flow	1													
Mretrf	-0.019	1												
CAPM Alpha	-0.048**	0.001	1											
Sharpe ratio	-0.034	0.324***	0.104***	1										
Score	0.040*	-0.376***	0.024	-0.033	1									
Escore	0.048**	-0.488***	0.043*	-0.081***	0.775***	1								
Sscore	0.049**	-0.322***	-0.003	-0.035	0.954***	0.700***	1							
Gscore	0.008	-0.134***	0.017	0.002	0.812***	0.338***	0.739***	1						
TF	-0.089***	0.104***	-0.038	0.006	-0.337***	-0.143***	-0.346***	-0.390***	1					
MF	-0.125***	-0.081***	-0.023	-0.041*	-0.300***	0.025	-0.348***	-0.443***	0.695***	1				
TNA	0.184***	-0.168***	0.032	-0.042*	0.256***	0.252***	0.258***	0.142***	-0.226***	-0.146***	1			
NER	0.018	0.381***	-0.050**	0.125***	-0.004	-0.077***	0.052**	0.064***	-0.083***	-0.142***	0.023	1		
GTS	0.057**	-0.654***	0.067***	-0.126***	0.681***	0.799***	0.614***	0.329***	-0.154***	0.051**	0.231***	-0.195***	1	
MIS	0.026	0.738***	-0.023	0.533***	-0.097***	-0.176***	-0.048**	-0.014	0.061***	-0.036	-0.080***	0.331***	-0.237***	1

Note: *p<0.1, **p<0.05, ***p<0.01.

4.3. Differential Analysis - T-Test

Before conducting the regression model, this study compared not only ESG performance but also the financial performance of ESG funds and non-ESG funds to assess the impact of ESG scores on fund performance. The following are the descriptive statistics for these two groups of funds.

Table 7. Differences between ESG funds and non-ESG funds.

Variables	ESG funds		non-ESG funds		ESG funds - non-ESG funds	t	p value
	N	Mean	N	Mean			
Score	274	70.77	2130	67.04	3.73	17.698	0.000***
Escore	274	71.9	2130	68.2	3.7	9.911	0.000***
Sscore	274	76.97	2130	71.87	5.1	18.871	0.000***
Gscore	274	65.34	2130	63	2.34	14.568	0.000***
Flow (million)	264	766.13	2090	261.87	504.26	2.513	0.012**
Mretrf (%)	264	-1.15	2106	-1.1	-0.05	-2.532	0.012**
CAPM Alpha (%)	181	0.49	1827	0.35	0.14	1.007	0.315
Sharpe ratio (%)	181	0.19	1827	0.24	-0.05	-1.894	0.06*

Note: *p<0.1, **p<0.05, ***p<0.01.

Table 7 analysis of the provided text indicates that ESG scores and the scores of the three pillars are significantly higher for ESG funds compared to non-ESG funds. This suggests that ETFs labeled as ESG indeed perform better in both overall ESG scores and individual component scores. Furthermore, the average fund flow for ESG funds is 766.13 million, whereas for non-ESG funds it is 261.87 million, indicating that ESG funds attract significantly higher capital inflows. This trend may reflect market recognition of sustainable investment principles and investor preference for ESG strategies. However, ESG funds show a notable disadvantage in terms of excess return (Mretrf), likely due to ESG investment screening limiting portfolio flexibility and impacting return potential. Although ESG funds exhibit slightly higher CAPM excess returns (CAPM Alpha), the difference is not statistically significant. Their risk-adjusted returns, measured by the Sharpe Ratio, are slightly lower than those of non-ESG funds, reaching statistical significance. This highlights the ongoing challenge of balancing risk control and return optimization within ESG investment strategies.

4.4. Linear Regression Analysis

1. Impact of ESG Scores on Fund Financial Performance

Table 8 presents the results of linear regression analyses for **Equations 8 to 11**. ESG scores have a significant negative impact on CAPM Alpha. A one standard deviation increase in ESG score would lead to a 0.209% decrease in CAPM Alpha. This suggests that ESG funds have relatively lower excess returns, and even though they attract more socially responsible investors, their financial performance may not necessarily outperform traditional funds. The impact of ESG scores on the Sharpe ratio is also significantly negative, indicating that funds with higher ESG scores have lower risk-adjusted returns. A one standard deviation increase in ESG score would lead to a 0.009% decrease in the Sharpe ratio. This suggests that ESG screening may limit the investment scope of funds and reduce their return potential.

From the linear regression results in **Table 8**, it can be concluded that while ESG scores may play a role in attracting investors, they have a negative impact on a fund's excess returns and risk-adjusted returns, indicating that ESG screening may limit a fund's investment options, leading to lower returns. The impact of fund manager fees and fund size on fund performance is also worth noting, particularly as high manager fees erode returns, while larger funds attract more capital inflows. The influence of market sentiment (GTS) and economic conditions (MIS) indicates that societal focus on ESG and the macroeconomic environment significantly impact fund performance.

Table 8. Linear regression results on the impact of ESG scores on fund financial performance.

Variables	Flow	Mretrf	CAPM Alpha	Sharpe ratio
Score_t-3/t-12	-18.473 (-0.475)	-0.000 (-1.510)	-0.045* (-1.956)	-0.002** (-2.363)
TF_t-1	-5914.266 (-0.642)	0.036 (0.609)	1.603 (0.307)	-0.001 (-0.006)
MF_t-1	-10930.000 (-0.518)	-0.310** (-2.244)	-16.002 (-1.330)	-0.425 (-1.252)
Mretrf_t-1	-6055.413 (-1.555)			
TNA_t-1	0.008*** (3.432)	0.000 (0.806)	0.000 (0.886)	0.000 (0.369)
NER_t-1	661.521 (0.445)	-0.018* (-1.864)	-0.198 (-0.236)	0.013 (0.545)
GTS_t-1	10.349 (0.055)	0.000 (0.125)	-0.130 (-1.218)	0.009** (2.885)
MIS_t-1	-6.872 (-0.005)	-0.009 (-0.958)	1.080 (1.354)	-0.077*** (-3.415)
Intercept	-4370.940 (-0.111)	-0.755** (-2.955)	-27.288 (-1.230)	2.449*** (3.912)
Y_t-1	0.096*** (3.634)	-0.006 (-0.227)	0.122*** (4.839)	0.895*** (77.308)
Fund style FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	1663	1663	1663	1663
Adj. R-squared	0.039	0.992	0.089	0.961

Note: *p<0.1, **p<0.05, ***p<0.01.

Table 9. Linear regression analysis results on the impact of environmental scores on fund financial performance.

Variables	Flow	Mretrf	CAPM Alpha	Sharpe ratio
Escore_t-3/t-12	37.191 (1.070)	-0.001*** (-2.955)	-0.047** (-2.473)	-0.000 (-0.173)
TF_t-1	-6397.505 (-0.696)	0.035 (0.585)	1.176 (0.226)	-0.028 (-0.192)
MF_t-1	-6217.907 (-0.323)	-0.234* (-1.885)	-6.754 (-0.624)	-0.077 (-0.250)
Mretrf_t-1	-5606.254 (-1.442)			
TNA_t-1	0.008*** (3.264)	0.000 (1.042)	0.000 (1.024)	0.000 (0.197)
NER_t-1	234.310 (0.156)	-0.015 (-1.519)	-0.033 (-0.039)	0.007 (0.278)
GTS_t-1	19.695 (0.104)	0.000 (0.076)	-0.131 (-1.225)	0.009*** (3.008)
MIS_t-1	-148.278 (-0.105)	-0.008 (-0.882)	1.087 (1.366)	-0.081*** (-3.612)
Intercept	-3657.675 (-0.093)	-0.764*** (-2.997)	-27.528 (-1.242)	2.473*** (3.943)
Y_t-1	0.096*** (3.643)	-0.009 (-0.355)	0.121*** (4.838)	0.898*** (77.188)
Fund style FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	1663	1663	1663	1663
Adj. R-squared	0.04	0.992	0.09	0.961

Note: *p<0.1, **p<0.05, ***p<0.01.

2. Impact of Environmental Scores on Fund Financial Performance

Table 9 presents the results of linear regression for the impact of environmental scores. Environmental scores (Escore) have a significant negative impact on excess returns (Mretrf), indicating that funds with higher

environmental scores may face lower excess returns. One standard deviation increase in E score would lead to a 0.006% decrease in excess return. The higher initial costs of environmental investment (e.g., construction costs for renewable energy) may reduce short-term returns, suggesting that the high costs of environmental investment put pressure on fund returns. The impact on CAPM Alpha is also significantly negative. One standard deviation increase in ESG score would lead to a 0.295% decrease in CAPM Alpha.

From the linear regression results in Table 9, it can be concluded that improvements in environmental scores have a complex impact on fund financial performance. While the effect on fund flows is not significant, the negative impact on fund returns (excess return and CAPM Alpha) suggests that the high costs of environmental investing may affect the overall performance of the fund. Fund size and management fees have a significant impact on fund performance, particularly as larger funds attract more capital, while higher management fees erode fund returns. Market attention to ESG issues (Google Trends score) promotes risk-adjusted returns (Sharpe ratio).

3. Impact of Social Score on Fund Financial Performance

Table 10 presents the linear regression results for the impact of social scores. The social score (Sscore) has a significant negative impact on excess return (Mretrf), CAPM Alpha, and Sharpe Ratio. A one standard deviation increase in S score would lead to a 0.006%, 0.248%, and 0.006% decrease in excess return, CAPM Alpha, and Sharpe Ratio, respectively. This may be because the profit potential of socially responsible investments has not yet been fully realized and has been suppressed in the short term due to its inability to translate into financial performance.

Table 10. Results of the linear regression analysis on the impact of social scores on fund financial performance.

Variables	Flow	Mretrf	CAPM alpha	Sharpe ratio
Sscore_t-3/t-12	-22.764 (-0.839)	-0.001*** (-2.574)	-0.042*** (-2.581)	-0.001** (-2.814)
TF_t-1	-5459.017 (-0.592)	0.049 (0.822)	2.532 (0.483)	0.024 (0.159)
MF_t-1	-13680.000 (-0.655)	-0.366*** (-2.680)	-18.549 (-1.558)	-0.473 (-1.406)
Mretrf_t-1	-6255.684 (-1.603)			
TNA_t-1	0.008*** (3.449)	0.000 (0.809)	0.000 (0.853)	0.000 (0.310)
NER_t-1	752.178 (0.505)	-0.016* (-1.678)	-0.091 (-0.108)	0.016 (0.665)
GTS_t-1	7.544 (0.040)	0.000 (0.098)	-0.131 (-1.225)	0.009*** (2.884)
MIS_t-1	25.235 (0.018)	-0.008 (-0.913)	1.090 (1.369)	-0.077*** (-3.414)
Intercept	-5064.192 (-0.129)	-0.762*** (-2.988)	-27.514 (-1.242)	2.437*** (3.895)
Y_t-1	0.095*** (3.615)	-0.009 (-0.369)	0.119*** (4.744)	0.893*** (76.570)
Fund style FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	1663	1663	1663	1663
Adj. R-squared	0.04	0.992	0.09	0.961

Note: *p<0.1, **p<0.05, ***p<0.01.

From the results of the linear regression in Table 10, it can be concluded that an increase in social scores has a negative impact on the financial performance of funds, particularly on excess returns, CAPM Alpha, and the Sharpe ratio, indicating that higher social scores may reduce return potential. Fund size has a significant positive impact on fund flows, with larger funds attracting more capital inflows and enhancing fund performance. Higher fund manager fees have a negative impact on excess returns, emphasizing the importance of considering management

fees when selecting funds. Market attention to ESG issues (GTS) has a positive impact on the fund's risk-adjusted returns (Sharpe ratio).

4. Impact of Corporate Governance Scores on Fund Financial Performance

Table 11 presents the results of the linear regression analysis for the impact of corporate governance scores. The impact of corporate governance scores (Gscore) on fund financial performance is relatively weak. Although its effects on cash flow and excess returns are not significant, it may have a slight negative impact on risk-adjusted returns (Sharpe ratio). The total net asset value of a fund has a significant impact on its performance, particularly as larger funds can attract more capital inflows. Market attention to ESG issues (GTS) demonstrates a positive impact on a fund's risk-adjusted returns (Sharpe ratio).

Table 11. Linear regression analysis results on the impact of corporate governance scores on fund financial performance.

Variables	Flow	Mretrf	CAPM Alpha	Sharpe ratio
Gscore_t-3/t-12	-37.266 (-1.167)	0.000 (0.639)	-0.008 (-0.414)	-0.001 (-1.552)
TF_t-1	-6307.255 (-0.686)	0.029 (0.488)	0.707 (0.136)	-0.033 (-0.221)
MF_t-1	-16880.000 (-0.801)	-0.182 (-1.329)	-7.835 (-0.655)	-0.295 (-0.876)
Mretrf_t-1	-6046.545 (-1.558)			
TNA_t-1	0.008*** (3.431)	0.000 (0.677)	0.000 (0.731)	0.000 (0.193)
NER_t-1	689.648 (0.467)	-0.020** (-2.101)	-0.373 (-0.446)	0.008 (0.356)
GTS_t-1	11.979 (0.063)	0.000 (0.217)	-0.120 (-1.125)	0.009*** (2.983)
MIS_t-1	-11.808 (-0.008)	-0.010 (-1.110)	0.962 (1.208)	-0.080*** (-3.568)
Intercept	-2919.162 (-0.074)	-0.750*** (-2.936)	-26.562 (-1.196)	2.490*** (3.973)
Y_t-1	0.094*** (3.566)	-0.003 (-0.120)	0.125*** (4.961)	0.897*** (77.619)
Fund style FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	1663	1663	1663	1663
Adj. R-squared	0.04	0.992	0.086	0.961

Note: **p<0.05, ***p<0.01.

Overall, while ESG metrics have some appeal for fund flows, their negative impact on fund financial performance suggests that fund managers must carefully balance financial returns with social responsibility objectives when selecting ESG investment strategies.

4.5. Nonlinear Regression Analysis

1. Impact of ESG Scores on Fund Financial Performance

Table 12 presents the nonlinear regression results for the nonlinear impact of ESG scores. An increase in ESG scores has a positive impact on fund excess returns (Mretrf) and CAPM Alpha, indicating that, in certain cases, funds with high ESG scores can generate higher returns. However, as ESG scores continue to rise, the growth rate of returns gradually slows down, indicating a negative nonlinear effect. The total net asset value (TNA) of a fund has a significant positive impact on fund flows, with larger funds attracting more capital inflows. The level of fund manager fees significantly affects fund returns, with higher manager fees eroding fund returns. Market attention to

ESG issues (GTS) has a positive impact on a fund's risk-adjusted returns, indicating that the rise of social responsibility has benefited fund performance.

Table 12. Nonlinear regression analysis results of the impact of ESG scores on fund financial performance.

Variables	Flow	Mretrf	CAPM Alpha	Sharpe ratio
Score_t-3/t-12	169.024 (0.241)	0.010* (2.041)	0.912* (2.046)	0.003 (0.264)
Score ² _t-3/t-12	-1.386 (-0.268)	-0.000* (-2.121)	-0.007* (-2.149)	-0.000 (-0.384)
TF_t-1	-6107.428 (-0.661)	0.030 (0.501)	1.025 (0.196)	-0.004 (-0.028)
MF_t-1	-10890 (-0.516)	-0.328* (-2.371)	-17.575 (-1.460)	-0.433 (-1.274)
Mretrf_t-1	-6095.840 (-1.564)			
TNA_t-1	0.008*** (3.441)	0.000 (1.009)	0.000 (1.094)	0.000 (0.405)
NER_t-1	637.343 (0.428)	-0.020* (-2.027)	-0.343 (-0.408)	0.012 (0.514)
GTS_t-1	7.098 (0.037)	-0.000 (-0.061)	-0.151 (-1.404)	0.009** (2.834)
MIS_t-1	-27.980 (-0.020)	-0.010 (-1.049)	1.009 (1.265)	-0.077*** (-3.426)
Intercept	-10130 (-0.226)	-1.089*** (-3.632)	-56.726* (-2.178)	2.298** (3.108)
Y_t-1	0.096*** (3.629)	-0.008 (-0.316)	0.118*** (4.709)	0.895*** (76.582)
Fund style FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	1968	1968	1968	1968
Adj. R-squared	0.036	0.992	0.103	0.960

Note: *p<0.1, **p<0.05, ***p<0.01.

To better understand the marginal effect of ESG scores on ETF performance in nonlinear models, we present two plots based on models with significant coefficients of ESG scores. Predicted performance measures (Mretrf and CAPM Alpha) are calculated using actual ESG scores, while holding other variables at their mean values. As shown in Figure 3, ETF financial performance increases with ESG scores up to approximately 63, after which it begins to decline as ESG scores rise further.

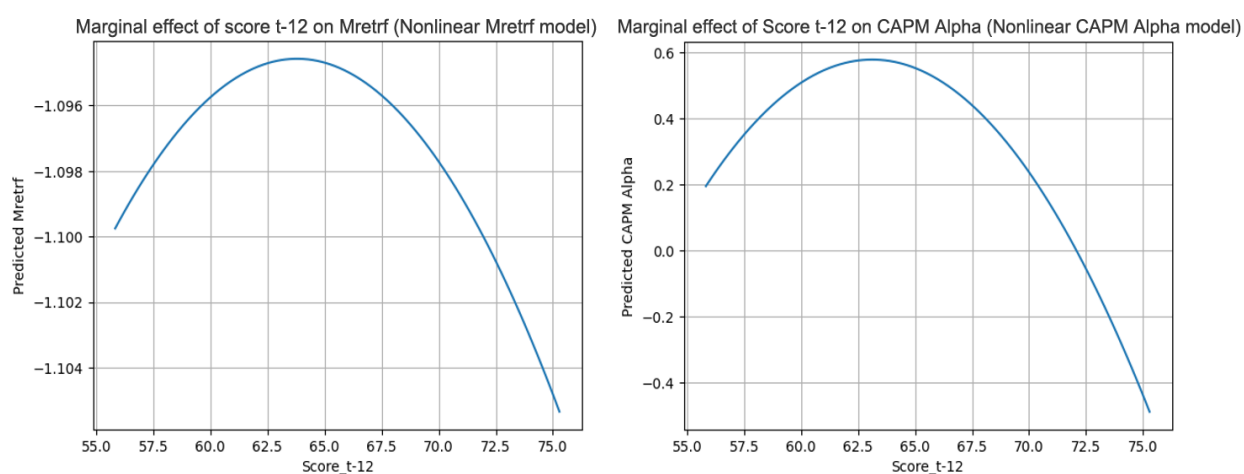


Figure 3. Marginal effect for nonlinear models.

2. Impact of Environmental Scores on Fund Financial Performance

Table 13 presents the results of the nonlinear regression analysis for the nonlinear impact of environmental scores. An increase in environmental scores has a relatively minor impact on fund financial performance. Although the squared term of the environmental dimension score shows some positive effects in the nonlinear model, these effects do not reach statistical significance. The total net asset value of the fund has a significant positive impact on fund flows, with larger funds being more likely to attract capital inflows. The level of fund manager fees has a significant impact on fund returns, with higher management fees weakening fund returns. Market attention to ESG (GTS) shows a positive impact on the fund's risk-adjusted return (Sharpe ratio), indicating that the rise of socially responsible investing has benefited fund performance. Overall, while environmental scores show a positive impact in some nonlinear models, their actual impact on fund financial performance is relatively small, and market attention to ESG and fund size may play a greater role in promoting fund performance.

Table 13. Nonlinear regression analysis results of the impact of environmental scores on fund financial performance.

Variables	Flow	Mretrf	CAPM Alpha	Sharpe ratio
Escore _{t-3/t-12}	-19.888 (-0.035)	-0.007 (-1.546)	-0.456 (-1.182)	-0.005 (-0.440)
Escore ² _{t-3/t-12}	0.428 (0.101)	0.000 (1.403)	0.003 (1.062)	0.000 (0.432)
TF _{t-1}	-6423.275 (-0.698)	0.035 (0.590)	1.192 (0.229)	-0.028 (-0.190)
MF _{t-1}	-5788.234 (-0.294)	-0.210* (-1.679)	-5.174 (-0.473)	-0.058 (-0.188)
Mretrf _{t-1}	-5593.151 (-1.437)			
TNA _{t-1}	0.008*** (3.210)	0.000 (0.897)	0.000 (0.913)	0.000 (0.153)
NER _{t-1}	233.031 (0.155)	-0.015 (-1.537)	-0.044 (-0.052)	0.007 (0.273)
GTS _{t-1}	20.608 (0.109)	0.000 (0.154)	-0.125 (-1.163)	0.009*** (3.027)
MIS _{t-1}	-142.787 (-0.101)	-0.007 (-0.812)	1.130 (1.417)	-0.081*** (-3.586)
Intercept	-1910.081 (-0.044)	-0.581** (-2.029)	-15.367 (-0.616)	2.613*** (3.700)
Y _{t-1}	0.096*** (3.643)	-0.010 (-0.388)	0.121*** (4.821)	0.898*** (77.168)
Fund style FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	1663	1663	1663	1663
Adj. R-squared	0.039	0.992	0.090	0.961

Note: *p<0.1, **p<0.05, ***p<0.01.

3. Impact of Social Scores on Fund Financial Performance

Table 14 presents the nonlinear regression results for the nonlinear impact of social scores. The impact of social scores on fund financial performance is relatively small, indicating that the influence of social scores on funds is relatively weak.

The total net asset value of funds has a significant positive impact on fund flows, with larger funds attracting more capital inflows. The level of fund manager fees has a significant impact on fund returns, with higher manager fees eroding fund returns. Market attention to ESG issues (GTS) has a positive impact on the fund's risk-adjusted return (Sharpe ratio), indicating that the rise of socially responsible investing has benefited fund performance. Overall, social scores have little impact on fund performance, while market attention to ESG issues and fund size may have a greater impact on fund performance.

Table 14. Nonlinear regression analysis results of the impact of social scores on fund financial performance.

Variables	Flow	Mretrf	CAPM Alpha	Sharpe ratio
Sscore_t-3/t-12	13.957 (0.036)	0.002 (0.910)	0.304 (1.323)	0.000 (0.051)
Sscore ² _t-3/t-12	-0.255 (-0.094)	-0.000 (-1.095)	-0.003 (-1.510)	-0.000 (-0.252)
TF_t-1	-5535.527 (-0.597)	0.046 (0.767)	2.134 (0.406)	0.022 (0.145)
MF_t-1	-13730.000 (-0.657)	-0.374*** (-2.733)	-19.472 (-1.634)	-0.478 (-1.418)
Mretrf_t-1	-6277.913 (-1.605)			
TNA_t-1	0.008*** (3.439)	0.000 (0.918)	0.000 (1.006)	0.000 (0.335)
NER_t-1	743.210 (0.498)	-0.017* (-1.755)	-0.187 (-0.222)	0.015 (0.645)
GTS_t-1	6.654 (0.035)	0.000 (0.032)	-0.141 (-1.314)	0.009*** (2.859)
MIS_t-1	22.753 (0.016)	-0.008 (-0.923)	1.080 (1.357)	-0.077*** (-3.413)
Intercept	-6325.596 (-0.152)	-0.861*** (-3.182)	-39.320* (-1.674)	2.380*** (3.579)
Y_t-1	0.095*** (3.612)	-0.010 (-0.392)	0.118*** (4.690)	0.892*** (76.045)
Fund style FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	1663	1663	1663	1663
Adj. R-squared	0.039	0.992	0.091	0.961

Note: *p<0.1, **p<0.05, ***p<0.01.

Table 15. Nonlinear regression analysis results of the impact of corporate governance scores on fund financial performance.

Variables	Flow	Mretrf	CAPM Alpha	Sharpe ratio
Gscore_t-3/t-12	-170.035 (-0.208)	0.015*** (2.893)	1.368*** (3.056)	0.013 (1.018)
Gscore ² _t-3/t-12	1.056 (0.163)	-0.000*** (-2.870)	-0.011*** (-3.075)	-0.000 (-1.081)
TF_t-1	-6131.307 (-0.662)	0.021 (0.345)	-0.129 (-0.025)	-0.042 (-0.285)
MF_t-1	-16280.000 (-0.761)	-0.286** (-2.019)	-17.517 (-1.420)	-0.392 (-1.125)
Mretrf_t-1	-6048.568 (-1.558)			
TNA_t-1	0.008*** (3.411)	0.000 (0.948)	0.000 (1.026)	0.000 (0.294)
NER_t-1	700.475 (0.474)	-0.023** (-2.379)	-0.637 (-0.760)	0.006 (0.251)
GTS_t-1	14.415 (0.076)	0.000 (0.017)	-0.144 (-1.343)	0.009*** (2.890)
MIS_t-1	-1.192 (-0.001)	-0.011 (-1.256)	0.843 (1.060)	-0.081*** (-3.609)
Intercept	921.223 (0.020)	-1.174*** (-3.985)	-65.833*** (-2.575)	2.093*** (2.882)
Y_t-1	0.094*** (3.568)	-0.010 (-0.380)	0.115*** (4.554)	0.895*** (76.456)
Fund style FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	1663	1663	1663	1663
Adj. R-squared	0.039	0.992	0.091	0.961

Note: **p<0.05, ***p<0.01.

4. The Impact of Corporate Governance Scores on Fund Financial Performance

Table 15 presents the nonlinear regression results for the nonlinear impact of corporate governance scores indicate that corporate governance scores have a positive impact on fund financial performance, particularly in terms of excess returns (Mretrf) and CAPM Alpha, suggesting that higher corporate governance scores can significantly enhance a fund's excess returns. However, when corporate governance scores are too high, this effect gradually weakens, demonstrating a nonlinear relationship.

The total net asset value of the fund has a significant positive impact on fund flows, with larger funds attracting more capital inflows. The level of fund manager fees also significantly impacts fund returns, with higher fees eroding returns. Market attention to ESG issues (GTS) positively influences a fund's risk-adjusted returns (Sharpe ratio), indicating that the rise of socially responsible investing has benefited fund performance. Overall, higher corporate governance scores significantly improve a fund's financial returns, but this growth in returns gradually slows as scores increase.

To examine the marginal effect of G scores on ETF performance in nonlinear models, we plot predicted performance measures (Mretrf and CAPM Alpha) using actual G scores while holding other variables at their means. Figure 4 indicates that ETF performance rises with G scores up to about 63, after which it declines.

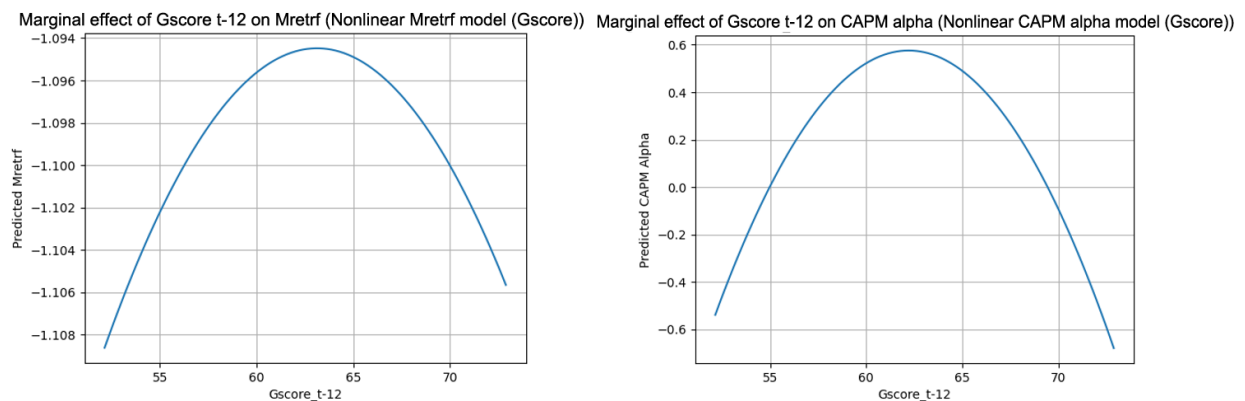


Figure 4. Marginal effect for nonlinear models.

To highlight anomalies such as the nonlinear positive effect of governance scores, we examine the performance of the three ESG dimensions among Taiwanese listed companies. Corporate governance emerges as the strongest dimension, with finance and technology firms frequently ranking highest in the “Sustainability Thermometer Index CSRone” survey.¹ The relatively low standard deviation of G scores indicates consistent governance performance across most companies, although the lowest G scores suggest that improvements in governance for a few firms could yield notable financial benefits. This aligns with our finding that the impact of G scores on ETF performance is positive when the score is below its mean value (63.271).

By contrast, environmental and social dimensions face ongoing challenges. In the environmental domain, energy transition and renewable energy adoption remain limited, particularly in energy-intensive sectors such as semiconductors. In the social dimension, attention to labor rights, diversity, and community engagement has increased, but disclosure and institutional implementation remain uneven. Structural constraints related to energy mix, resource allocation, and supply chain management continue to limit overall performance.

Overall, the effect of ESG scores on fund returns exhibits a nonlinear pattern. While initial improvements in ESG, particularly governance, can enhance excess returns and CAPM Alpha, the marginal benefit diminishes as scores rise and may even become negative at high levels, as reflected in the negative coefficient of the squared ESG

¹ https://cgc.twse.com.tw/latestNews/promoteNewsArticleCh/3752?utm_source=chatgpt.com.

term. Additionally, higher fund manager fees significantly reduce returns, further highlighting the importance of governance quality and cost management for ETF performance.

4.6. Piecewise Linear Regression Model Analysis

Table 16 presents the results of the piecewise linear regression analysis from equations (12) to (15). R1 and R2 represent the high (bottom 50%) and low (top 50%) rankings of Google Trends scores, respectively, aiming to investigate whether the impact on the fund differs when Google Trends scores are higher or lower. Changes in Google Trends scores exhibit differing impacts on fund financial performance, particularly when Google Trends scores are lower (R2), where excess returns (Mretrf) show a significant positive increase, while in the higher score range (R1), a negative impact is observed. This indicates that heightened market attention to ESG-related topics (GTS) has a positive effect on enhancing fund returns.

Overall, Google Trends scores have a significant impact on fund excess returns (Mretrf), particularly when Google Trends scores are high, with fund returns showing a noticeable improvement effect.

Table 16. Piecewise linear regression test of the impact of fund financial performance on Google Trends scores.

Variables	Flow	Mretrf	CAPM alpha	Sharpe ratio
R1_t-1	-1056.323 (-0.832)	-0.016** (-1.970)	-0.465 (-0.652)	-0.009 (-0.464)
R2_t-1	1022.094 (0.488)	0.028** (2.075)	0.510 (0.432)	0.015 (0.443)
Score_t-3/ t-12	-22.976 (-0.585)	-0.000 (-1.623)	-0.046** (-2.003)	-0.002** (-2.384)
TF_t-1	-2951.877 (-0.301)	0.062 (0.967)	2.812 (0.506)	0.016 (0.102)
MF_t-1	-17280.000 (-0.775)	-0.356** (-2.453)	-18.420 (-1.455)	-0.457 (-1.281)
TNA_t-1	0.009*** (3.520)	0.000 (0.911)	0.000 (0.964)	0.000 (0.400)
Mretrf_t-1	-6130.422 (-1.573)			
NER_t-1	672.954 (0.452)	-0.018* (-1.839)	-0.196 (-0.233)	0.013 (0.549)
MIS_t-1	-21.979 (-0.011)	-0.007 (-0.553)	1.552 (1.319)	-0.107*** (-3.208)
Intercept	-4209.853 (-0.072)	-0.800** (-2.120)	-40.766 (-1.240)	3.283*** (3.537)
Y_t-1	0.094*** (3.581)	-0.007 (-0.264)	0.121*** (4.831)	0.895*** (77.108)
Fund style FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	1663	1663	1663	1663
Adj. R-squared	0.039	0.992	0.088	0.961

Note: *p<0.1, **p<0.05, ***p<0.01.

If we further analyze the interaction between Google Trend Rank and ESG score on ETF excess returns, we calculate the expected excess returns using the actual values of the interaction term while holding other variables at their means, and present the results in Figure 5. The figure shows that ETFs with both high search rankings and high ESG scores exhibit lower excess returns.

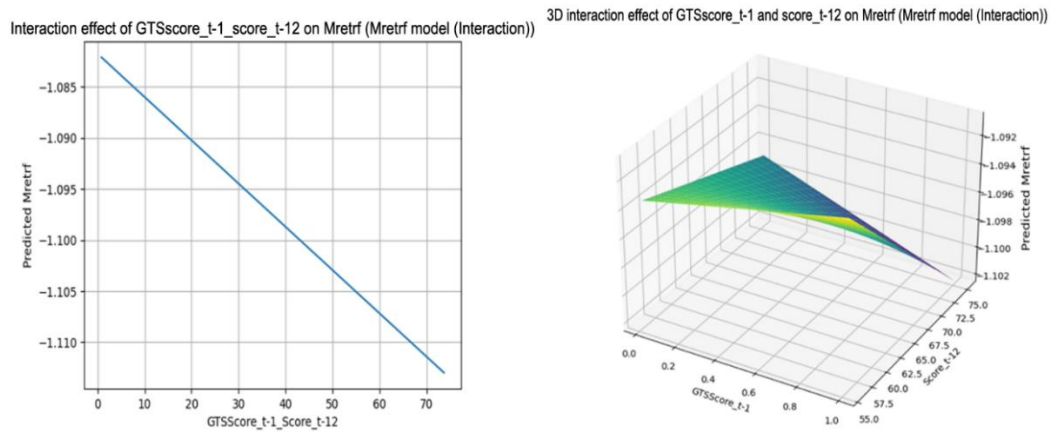


Figure 5. Interaction effect of Google trend rank and ESG score on ETF's market excess return.

5. CONCLUSIONS

This study finds that ESG factors attract higher fund inflows but do not consistently enhance performance. ESG funds underperform in excess returns and Sharpe ratios, with nonlinear patterns suggesting that very high ESG scores may reduce returns. Governance scores have a diminishing positive effect, while environmental and social scores show negative impacts, possibly due to high implementation costs. Fund size boosts inflows, whereas higher fees lower returns. Market attention to ESG improves returns only when attention is low.

5.1. Investment Implications

Investors should be cautious of overconcentration in high-ESG-score funds and consider the trade-off between sustainability goals and short-term returns. A balanced allocation favoring moderate ESG scores, low fees, and funds benefiting from strong governance may capture both sustainability value and competitive performance over the long term.

5.2. Policy Implications

This study suggests that both the transition costs of ESG investments and ETF regulatory restrictions on constituent selection may contribute to weaker short-term performance. In Taiwan's evolving ETF and ESG landscape, easing stock selection rules such as the exclusion of small-cap firms could enhance diversification and direct capital toward firms with greater potential for ESG improvement, particularly in the environmental and social dimensions. Strengthening oversight of greenwashing and improving ESG transparency would further safeguard investors while promoting regulatory refinement, sustainable finance, and long-term value creation.²

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Data Availability Statement: Upon a reasonable request, the supporting data of this study can be provided by the corresponding author.

Competing Interests: The authors declare that they have no competing interests.

Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.

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² We thank the anonymous referee for providing this constructive suggestion.

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