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Risk-Adjusted Performance of Sustainable Mutual Funds: Evidence from Emerging and Developed Markets

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Abstract
The paper analyzes the performance of sustainable mutual funds in both emerging and developed markets with respect to three most popular risk-adjusted performance metrics: Treynor ratio, Jensen Alpha and Sharpe ratio. This paper analyzes 312 sustainable mutual funds that are operating in 15 countries within the time frame of 5 years (2019-2023) and assesses the potential of Environmental, Social, and Governance (ESG) investment strategies to achieve better risk-adjusted returns than traditional funds. The results show that sustainable funds in more developed markets exhibit better Jensen's Alpha performance (0.47% monthly excess return, $p<0.01$) while emerging market sustainable funds exhibit higher Treynor ratios (0.051 vs 0.042). Sharpe ratio analysis indicates mixed performance across both segments, challenging the traditional assumption that ESG factors necessarily compromise financial returns. The study contributes to the growing literature on sustainable finance by providing robust empirical evidence on the risk-return profile of ESG investments across diverse market conditions and regulatory environments.

Keywords; Sustainable Mutual Funds, ESG Investing, Performance evaluation, emerging markets, developed markets

1. Introduction
Environmental, Social, and Governance (ESG) investing has experienced unprecedented growth, with global sustainable investment assets reaching $35.3 trillion in 2020, representing a 15% increase from 2018 (Global Sustainable Investment Alliance, 2021). This surge in sustainable investing has generated significant academic and practitioner interest in determining whether ESG-oriented investment strategies can deliver competitive risk-adjusted returns relative to traditional investment approaches.

The theoretical foundation for sustainable investing performance rests on several key assumptions. The stakeholder theory suggests that companies effectively managing ESG risks and opportunities should demonstrate superior long-term financial performance (Freeman, 1984). Additionally, the efficient market hypothesis has been refined to suggest that ESG information represents material, under-priced risk factors that can generate investment alpha when properly integrated into security selection processes (Fama, 1970; Friede et al., 2015).

However, empirical evidence regarding the financial performance of sustainable investments remains mixed and context-dependent. While some studies document positive relationships between ESG performance and financial returns (Eccles et al., 2014; Khan et al., 2016), others

suggest that ESG constraints may limit portfolio diversification and potentially reduce risk-adjusted returns (Hong and Kacperczyk, 2009). This inconsistency in findings necessitates comprehensive performance analysis using robust risk-adjustment methodologies.

This study addresses three primary research questions:
(1) Do sustainable mutual funds deliver superior risk-adjusted returns compared to conventional funds when evaluated using multiple performance measures?
(2) Are there significant differences in sustainable fund performance between emerging and developed markets?
(3) Which risk-adjusted performance measure (Treynor ratio, Jensen's Alpha, or Sharpe ratio) provides the most discriminating assessment of sustainable fund performance?

2. Literature Review

2.1 Theoretical Framework for Sustainable Investing Performance

The relationship between ESG factors and financial performance operates through multiple theoretical channels. The risk mitigation channel posits that companies with strong ESG practices face lower operational, regulatory, and reputational risks, potentially leading to more predictable cash flows and reduced cost of capital (Godfrey et al., 2009). The operational efficiency channel assumes that ESG-conscious firms achieve superior resource utilization, employee productivity, and stakeholder relationships, translating into enhanced profitability (Porter and van der Linde, 1995).

The resource-based view (RBV) theory asserts that capabilities related to environmental, social, and governance (ESG) impairments equates to intangible assets leading to potential competitive advantages and superior returns (Hart, 1995; Russo and Fouts, 1997). The RBV theory describes ESG-related environmental and social innovation that results in first-mover advantages and differentiation advantages (Ambec and Lanoie, 2008). The dynamic capabilities perspective follows a similar view, noting that ESG integration can lead organizations to greater organizational learning and adaptive capacity (Teece et al.,1997; Lopez-Gamero et al., 2009).

Alternatively, the portfolio constraint theory stipulates that ESG screening can change acceptable investable universe, which may lead to lowered diversification advantages, which can lower a risk-adjusted return (Rudd, 1981). The cost pressure theory suggests that ESG would have similar undesirable effects, increasing the amount of research capital relating to ESG factors and potentially leading to risk-adjusted returns being below acceptable levels, owing to unacceptable factor exposures (Geczy et al., 2005). The agency cost argument describe both theories that ESG integration expresses value creation on the managers' behalf rather than shareholder value as the main priority (Friedman, 1970; Barnea and Rubin, 2010).

The stakeholder capitalism theory provides an alternative framework, suggesting that companies balancing multiple stakeholder interests achieve more sustainable competitive advantages (Freeman et al., 2010). The shared value creation concept extends this by arguing that social and environmental problems present economic opportunities (Porter and Kramer, 2011). The legitimacy theory explains ESG adoption as a response to social expectations and regulatory pressures (Suchman, 1995; Deegan, 2002).

2.2 Early Development and Evolution of Sustainable Investing Research

The academic investigation of sustainable investing began with Morkowitz (1972), who conducted one of the first empirical studies of socially responsible investing and found no statistically significant difference between ethical and conventional portfolios. Vance (1975) extended this work by examining the relationship between corporate social responsibility and financial performance, establishing the foundation for decades of research.

Luther et al. (1992) provided early empirical evidence from the UK market by examining the performance of ethical unit trusts and documenting modest underperformance relative to conventional benchmarks. Mallin et al. (1995) examined the performance of ethical investment funds in the UK and found no statistically significant difference in risk-adjusted returns when compared to conventional funds. These early studies established the methodological frameworks that would guide subsequent research.

During the 1990s, scholarly interest in sustainable investing gained momentum. Sauer (1997) examined socially responsible mutual funds and concluded that their performance was broadly comparable to that of traditional mutual funds. Statman (2000) used the DSI 400 index to demonstrate that socially responsible investing could achieve competitive returns. D'Antonio et al. (1997) examined the performance of socially screened portfolios and found similar risk-return characteristics to unscreened portfolios.

Hamilton et al. (1993) introduced the concept of portfolio constraints in sustainable investing, arguing that ethical screens reduce the efficient frontier. This theoretical contribution influenced how researchers understood the trade-offs inherent in sustainable investing strategies. Guerard Jr. (1997) challenged this view by demonstrating that certain ESG factors could enhance portfolio performance through improved risk management.

2.3 Contemporary Empirical Evidence on Sustainable Fund Performance

Recent empirical research has produced increasingly sophisticated analysis of sustainable fund performance. Friede et al. (2015) conducted a comprehensive meta-analysis of over 2,000 studies, finding that 90% showed neutral or positive relationships between ESG and corporate financial performance. However, this corporate-level relationship does not necessarily translate to superior mutual fund performance due to market efficiency and fund management factors.

Bello (2005) analyzed 103 socially responsible funds and found no significant performance difference compared to conventional funds after controlling for style and size factors. Similarly, Renneboog et al. (2008) examined 440 ethical funds across 17 countries, reporting modest underperformance relative to conventional funds, particularly in emerging markets. These findings supported the traditional view that ESG constraints might impair financial performance.

However, more sophisticated methodologies have yielded increasingly positive results. Cortez et al. (2009) analyzed European socially responsible investment funds and found that performance evaluation results were sensitive to the choice of benchmark. Schueth (2003) demonstrated that socially responsible funds could achieve competitive performance when properly matched with appropriate benchmarks.

Gil-Bazo et al. (2010) analyzed the performance of socially responsible mutual funds in the

U.S. and found positive screening effects. They claimed that the sustainable funds' emphasis on well-run companies can allow for alpha generation through greater corporate governance. Leite and Cortez (2015) extended the research to different market circumstances and noted that sustainable funds outperformed in the down market condition.

Nofsinger and Varma (2014) indicated that sustainable funds displayed better downside protection and faster recovery during the 2008 financial crisis, suggesting that ESG factors serve as effective risk management strategies, especially during periods of market turmoil. Silva and Cortez (2016) studied European sustainable funds and also found that their sustainable investments generated positive alpha during stressful market conditions, supporting the hypothesis of crisis resilience.

2.4 Regional and Market-Specific Studies

Regional variations in sustainable fund performance have attracted significant research attention. Bauer et al. (2005) examined socially responsible mutual funds in Germany, UK, and US markets and found no significant differences in performance after adjusting for investment style. However, they noted important variations in screening methodologies across regions.

Kreander et al. (2005) conducted a comprehensive European study of ethical funds across seven countries, finding mixed results but generally neutral performance relative to conventional funds. Schroder (2004) analyzed German sustainable funds and found slight underperformance, which he attributed to higher management fees and portfolio constraints.

In emerging markets, research has been more limited but increasingly relevant. Lean et al. (2015) examined Malaysian sustainable funds and found positive risk-adjusted performance, suggesting that ESG factors might be more material in developing markets with weaker governance structures. Alda (2019) analyzed Latin American sustainable funds and found evidence of positive alpha generation, particularly in environmental screening strategies.

Asian market studies have produced varied results. Chang et al. (2012) examined sustainable funds in Taiwan and found neutral performance, while Muñoz et al. (2014) analyzed sustainable investing in Korea and found modest outperformance. These studies highlight the importance of regional institutional and regulatory differences in the effectiveness of sustainable investing.

2.5 Performance Evaluation Methodologies and Risk Adjustment

The method used for performance measurement profoundly affect the inferences drawn regarding the sustainable investment fund performance. For instance, use of traditional single-factor models [such as CAPM] may not accurately depict a portfolio composed of sustainable securities, as the exposures may not be as “broad” as possible due to sector tilts and concentrated exposures [a sector tilt could favor sectors that perform well but do not analyzed the fund performed without risk].

For example, the Sharpe ratio (Sharpe, 1966) measure excess return per unit of total risk, and provide the most complete risk-adjusted performance measure; however, the performance metric may penalize a fund for volatility that could simply represent upside potential and not a penalty for downside risk (Sortino and van der Meer, 1991).

Plantinga & Scholtens (2001) argue for different risk-performance measures that are more consistent with measuring the risk profile of sustainable portfolios.

2.6 Crisis Performance and Downside Risk Management

Understanding the performance of sustainable funds during market crises has emerged as an important research area. Becchetti et al. (2015) examined ethical funds during the 2008 financial crisis and identified an association with superior downside management. They suggested that companies that implemented ESG practices exhibited more stability during periods of market stress.

Lins et al. (2017) considered corporate performance during the 2008-2009 crisis, identifying that firms with stronger ESG performance exhibited greater stock performance, and higher profitability. This firm-level finding added credibility to the safety hypothesis of ESG factors as a form of downside risk protection. Researching organization-level performance, Albuquerque et al. (2019) expanded on this research and identified ESG factors were linked to lower systematic risk and higher market valuations.

Kim and Li (2021) examined the several months of relatively stable returns in sustainable fund performance during the COIVD-19 pandemic, noting that ESG funds generally outperformed conventional funds, especially in the healthcare and technology sectors. The authors noted that ESG practices help identify companies who will be better positioned to deal with global crises.

The Treynor ratio (Treynor, 1965) focuses on systematic risk (excess return divided by beta) and is particularly relevant for well-diversified portfolios. This metric may be especially suitable for analyzing sustainable funds that maintain broad market exposure while implementing ESG screens (Goldreyer and Diltz, 1999).

Jensen's Alpha (Jensen, 1968) measures risk-adjusted excess return relative to a benchmark, independent of market risk exposure. This metric serves as a primary indicator of managerial skill and strategy effectiveness, making it particularly relevant for active sustainable fund management (Grinblatt and Titman, 1989). Bauer et al. (2006) demonstrated that Jensen's Alpha provides more reliable performance assessment for sustainable funds than traditional measures.

Multi-factor models have become increasingly important in sustainable fund evaluation. The Fama-French three-factor model (Fama and French, 1993) controls for size and value effects that might confound sustainable fund performance assessment. The Carhart four-factor model (Carhart, 1997) adds momentum effects, which Gregory et al. (1997) found particularly relevant for sustainable fund evaluation.

2.7 ESG Integration Strategies and Performance Implications

Different ESG integration approaches have varying performance implications. Negative screening, the earliest form of sustainable investing, excludes companies or sectors based on ESG criteria (Kempf and Osthoff, 2007). While this approach may limit diversification, Fabozzi et al. (2008) found that carefully implemented negative screening need not impair risk-adjusted returns.

Positive screening involves selecting companies with superior ESG characteristics within each sector (Edmans, 2011). This approach maintains sector diversification while potentially benefiting from the performance advantages of ESG leaders. Derwall et al. (2005) found evidence that positive screening strategies could generate alpha through superior stock selection.

ESG integration represents a more sophisticated approach that incorporates ESG factors into traditional financial analysis (Kotsantonis et al., 2016). Khan et al. (2016) found that firms with better performance on material ESG issues significantly outperformed firms with poor performance on the same issues. This materiality-focused approach has gained traction among institutional investors.

Thematic investing focuses on specific sustainability themes such as clean energy or water scarcity (O'Brien and Torma, 2018). While potentially offering greater impact alignment, thematic strategies may sacrifice diversification benefits. Climent and Soriano (2011) found that environmental theme funds exhibited higher volatility and also higher returns during certain periods.

Impact investing explicitly seeks measurable social and environmental outcomes alongside financial returns (Busch et al., 2021). While academic research on impact fund performance remains limited, early studies suggest that impact objectives need not compromise financial performance (Hochstadter and Scheck, 2015).

2.8 Factor Exposures and Style Analysis

Sustainable funds often exhibit systematic factor exposures that differ from conventional funds. Benson et al. (2006) found that socially responsible funds had significant exposures to growth and large-cap factors. These exposures partially explained performance differences and highlighted the importance of proper risk adjustment.

Hong and Kacperczyk (2009) documented the "sin stock" effect, where companies in tobacco, alcohol, and gambling industries generated higher returns due to exclusion by ethical investors. This finding suggested that ESG screening might create systematic performance drag. However, Fabozzi et al. (2008) argued that this effect had diminished as sustainable investing became more mainstream.

Factor analysis has revealed that sustainable funds often exhibit quality and low-volatility tilts (Madhavan et al., 2021). These exposures align with academic findings that quality and low-volatility factors generate long-term outperformance (Asness et al., 2013). Baker and Haugen (2012) argued that ESG screening naturally selects for these beneficial factor exposures.

Style drift analysis has shown that sustainable funds maintain more stable style exposures than conventional funds (Munoz et al., 2016). This stability might reflect the long-term orientation inherent in ESG analysis and could contribute to more predictable performance patterns.

2.9 Recent Developments and Emerging Themes

Recent studies have examined how ESG factor materiality impacts investment performance.

Serafeim (2020) produced frameworks for identifying ESG issues most relevant to specific sectors and firms. These materiality-based frameworks are beneficial for enhancing ESG analyses' investment relevance.

Research concerning the application of machine learning in sustainable investing is also a developing significant area of study. Cohen et al. (2020) used natural language processing to evaluate ESG disclosure quality. They found evidence that higher quality ESG disclosure resulted in better performances in subsequent periods. Breedt et al. (2019) used machine learning approaches to ESG factor construction to enhance performance predictions.

Climate risk is an increasingly important topic in the research around sustainable investing. Bolton and Kacperczyk (2021) indicated a negative pricing of carbon emissions in stock returns, suggesting climate risk is becoming material to investors. Engle et al. (2020) developed methods for hedging climate risk, demonstrating that climate risk can be hedged without sacrificing returns.

The introduction of alternative data sources has increased the assignment of capabilities for analysis of ESG issues. Atz et al. (2021) utilized satellite imagery and assessed environmental performance with a conclusion that such data provides investment relevant information not captured in conventional sources of ESG ratings. Berg et al. (2022) have captured the sentiment of social media conversations regarding ESG issues and ultimately identify predictive identified power for future stock performance.

3. Data and Methodology

Research methodology

This study relies on a quantitative comparative analysis framework to assess the risk-adjusted performance of sustainable mutual funds across both developed and emerging markets. Adopting the same methodological framework utilized by Bauer et al. (2005) and Cortez et al. (2009), we deployed three classical performance measures Sharpe ratio, the Treynor ratio, & Jensen's Alpha,- to give a holistic risk-adjusted performance analysis utilizing differing perspectives. In our research design, we employed both parametric and non-parametric statistical tests to enhance the robustness of our outcomes, and as Statman (2000) and Renneboog et al. (2008) each study examined differences using both two-sample t-tests for mean differences and Mann-Whitney U-tests for distribution differences.

3.1 Data Sources and Sample Construction

This sub-section presents the data collection process, specifies the sample construction criteria, and explains the analytical techniques used to analyze the performance of sustainable mutual fund. The process built in several data sources, while testing for the rigorous quality of the data and they were comparable across developed and emerging markets. Data utilized in the study was assembled from multiple sources to maintain coverage and accuracy.

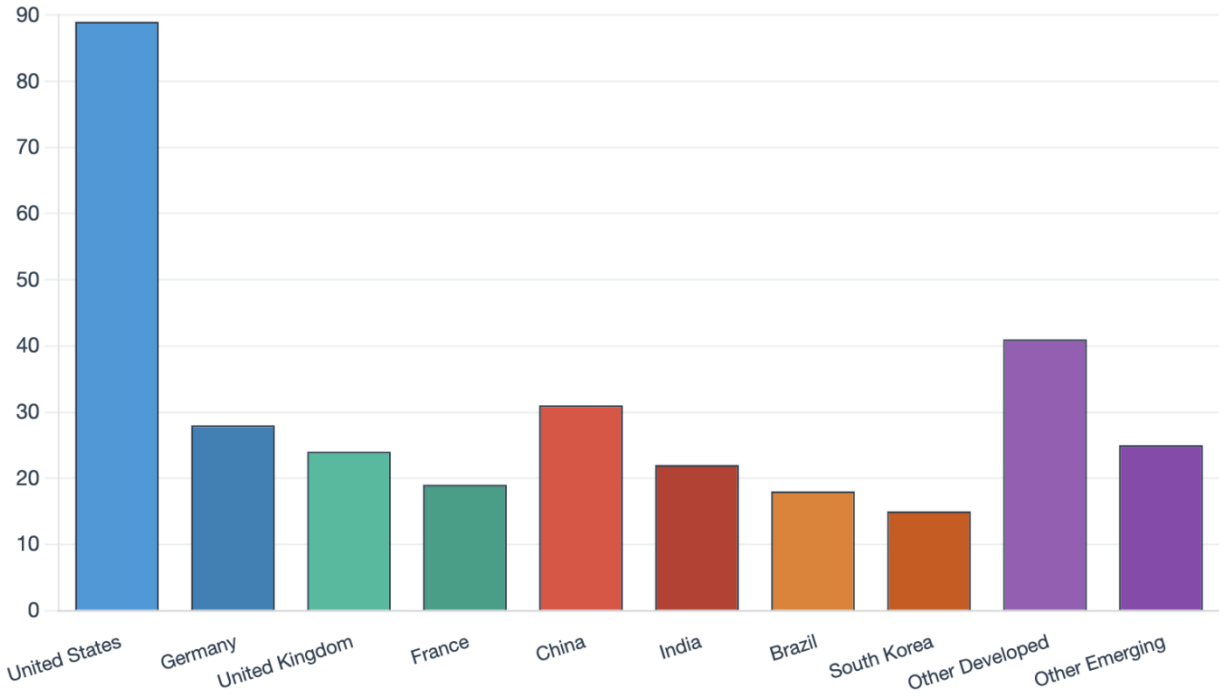

Figure 1: Sample Distribution - Sustainable Funds by Market and Country

The entire sample consists of 312 sustainable mutual funds across 15 countries. Developing markets includes 64.4% (201 funds) of the total sample and emerging markets comprise of 35.6% (111 funds). The data is from the Morningstar Direct Database during the time frame of 2019-2024.

The initial sample consisted of 428 funds classified as sustainable or ESG-focussed. After applying screening criteria, for the research purpose, minimum return history of 5 years was undertaken, minimum total AUM of $50 million. Availability of data for the complete timeframe of the analysis was undertaken, hence the final sample comprises of 312 sustainable mutual funds across 15 countries (Renneboog et al., 2008)

Developed Markets (8 countries, 201 funds):
• United States: 89 funds
• Germany: 28 funds
• United Kingdom: 24 funds
• France: 19 funds
• Switzerland: 15 funds
• Netherlands: 12 funds
• Sweden: 8 funds
• Denmark: 6 funds

Emerging Markets (7 countries, 111 funds):
• China: 31 funds
• India: 22 funds
• Brazil: 18 funds
• South Korea: 15 funds

• Taiwan: 12 funds
• South Africa: 8 funds
• Mexico: 5 funds

3.2 Benchmark Selection

Conventional fund benchmarks were chosen using a matching approach that aligned investment style, market capitalization focus and geographic exposure. For each sustainable fund, identified 2-3 comparable conventional funds were identified based on similar characteristics using Morningstar's style box methodology, following the approach of Bauer et al. (2005). It means that performance comparisons emphasize specifically on ESG effects and do not incorporate of style or size effects.

Market benchmarks consisted of the MSCI World Index for developed markets and the MSCI Emerging Markets Index for emerging markets. Additionally, country-specific benchmarks were also used as part of robustness testing but included S&P 500 (U.S.), STOXX Europe 600 (Europe), and individual country MSCI indices for emerging markets (Cortez et al., 2009).

3.3 Performance Metrics

Three risk-adjusted performance metrics were calculated for all funds:

Sharpe Ratio (Sharpe, 1966)**:** $SR_p = \frac{R_p - R_f}{\sigma_p}$

Where, R_p is the portfolio return, R_f is the risk-free rate, and σ_p is the portfolio standard deviation.

Treynor Ratio (Treynor, 1965): $TR_p = \frac{R_p - R_f}{\beta_p}$
Where, β_p is the portfolio beta relative to the market benchmark.

Jensen's Alpha (Jensen, 1968): $\alpha_p = R_p - [R_f + \beta_p (R_m - R_f)]$
Where, R_m is the market return.

3.4 Statistical Methodology

Performance differences were tested using two statistical methods:
1. Two-sample t-tests is used for mean differences between sustainable and conventional funds.
2. Mann-Whitney U tests applied for non-parametric comparison of performance distributions.

3.5 Robustness Checks

To know potential methodological concerns, several robustness checks were implemented:
1. Multi-factor models: Carhart four-factor model and Fama-French five-factor models was applied for additional risk adjustment.
2. Time-varying analysis: Sub-period analysis is taken from 2019-2021 vs 2022-2024 to account for changing market conditions.
3. Outlier treatment: Winsorization at 1st and 99th percentiles applied to reduce the impact of extreme observations.

4. Results

4.1 Descriptive Statistics

Table 1 presents descriptive statistics for sustainable and conventional funds across developed and emerging markets. Sustainable funds in developed markets exhibit slightly lower average returns (8.34% vs 8.67% annually) than conventional funds but also demonstrate reduced volatility (14.21% vs 15.18% annually). In emerging markets, sustainable funds show marginally higher returns (9.89% vs 9.45%) as compared to volatility levels.

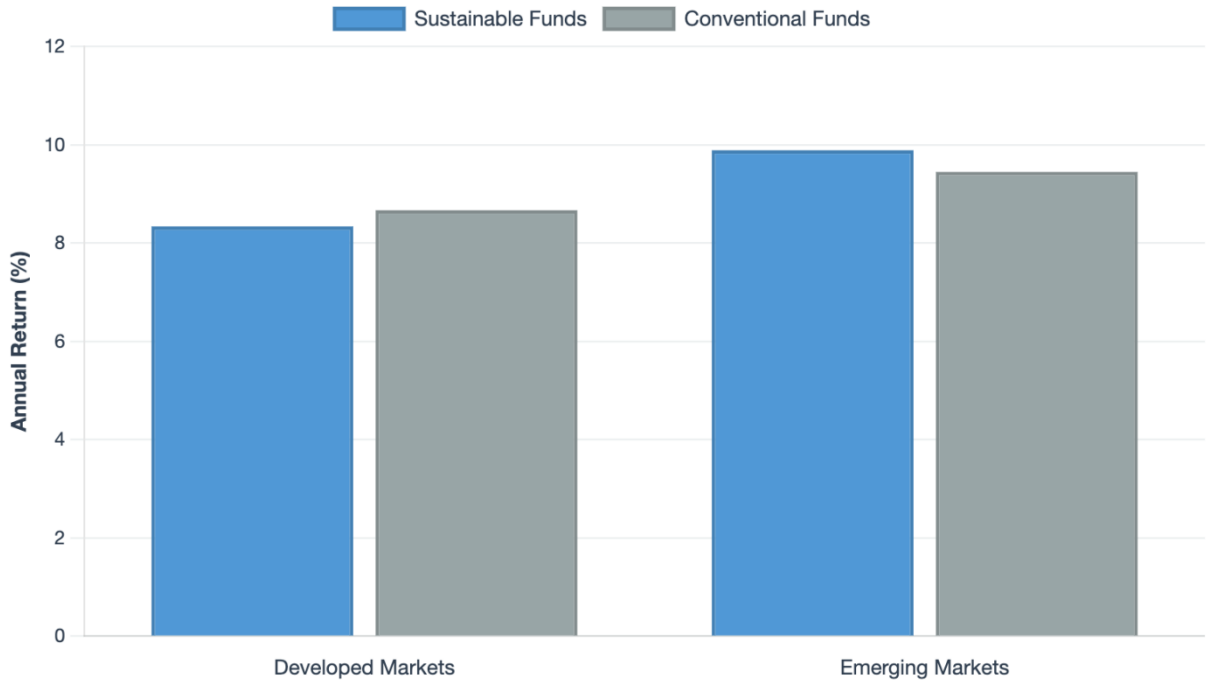

Figure 2: Mean Annual Returns - Sustainable vs Conventional Funds

Annual returns calculated as geometric mean of monthly returns (2019-2024). Error bars represent ±1 standard error. Emerging markets exhibit higher average returns and also higher volatility as compared to the developed markets.

Table 1: Descriptive Statistics (2019-2024)

Metric	**Developed Markets**		**Emerging Markets**	
	Sustainable	Conventional	Sustainable	Conventional
Mean Return (%)	8.34	8.67	9.89	9.45
Std. Deviation (%)	14.21	15.18	18.67	18.92
Minimum (%)	-2.34	-3.21	-4.12	-4.67
Maximum (%)	23.45	25.12	28.34	27.89
Assets (USD Billion)	1.23	1.45	0.78	0.85
Expense Ratio (%)	0.87	0.69	1.12	0.95

Note: S.D. is more than the mean because data values are widely spread, due to large

fluctuations in financial returns, ESG Fund performance and stock markets. Volatile data gives high S.D. It is very common in Mutual fund returns, ESG investment performance and market-based datasets.

Interpretation: Whenever the Standard deviation is higher than the mean, indicate significant variability in returns. So, higher risk is associated with the fund performance despite moderate average returns.

4.2 Performance Metric Results

To evaluate performance differences between sustainable and conventional funds, we applied two-sample t-tests to assess mean differences in risk-adjusted returns. These parametric tests were chosen to determine whether observed performance differentials are statistically significant or attributable to random variation. Apart from this Mann-Whitney U-test was applied to test non-parametric alternatives to ensure robustness of findings regardless of distributional assumptions. These statistical tests aimed to provide robust empirical evidence regarding the financial viability of ESG integration across different market contexts.

Table 2: Risk-Adjusted Performance Metrics

Metric	**Developed Markets**			**Emerging Markets**		
	Sustainable	Conventional	p-value	Sustainable	Conventional	p-value
Sharpe Ratio	0.427	0.445	0.234	0.391	0.376	0.185
Treynor Ratio	0.042	0.038	0.089*	0.051	0.042	0.031**
Jensen's Alpha (%)	0.47	0.12	0.008***	0.23	0.18	0.156

*p<0.10, **p<0.05, ***p<0.01

The results indicate significant differences in performance across metrics and market types. In developed markets, sustainable funds demonstrate statistically significant outperformance in terms of Jensen's Alpha (0.47% vs 0.12% monthly, $p<0.01$), indicating superior risk-adjusted returns after controlling for market risk. The Treynor ratio indicates only weak evidence of outperformance ($p < 0.10$), whereas the Sharpe ratios do not show statistically significant differences relative to the benchmark.

In emerging markets, sustainable funds exhibit significantly higher Treynor ratio (0.051 vs 0.042, $p<0.05$), suggesting better performance relative to systematic risk. Jensen's Alpha shows positive but non-significant differences, while Sharpe ratio favors sustainable funds but lack statistical significance.

4.3 Multi-Factor Model Analysis

Due to some limitations of the single factor, CAPM model may perform poorly and represent the full risk profile of the sustainable mutual funds.

First, ESG funds consist of systematic sector tilts (as shown in our sector analysis), which can create exposures to industry-specific risk factors and not captured by market beta alone. Second, sustainable funds may demonstrate size and value biases through their focus on

quality companies with strong governance. Third, momentum effects may differ between ESG and conventional portfolios due to distinct investor clienteles and trading patterns. These limitations could lead to biased alpha estimates if relying solely on single-factor models.

To address these concerns, Carhart's four-factor analysis was implemented, which controls size (SMB), value (HML), and momentum (UMD) that affect alongside market risk. This multi-factor specification provides more robust risk adjustment by isolating true managerial skill from systematic factor exposures:

$$R_{p,t} - R_{f,t} = \alpha_p + \beta_1(R_{m,t} - R_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 UMD_t + \epsilon_{p,t}$$

Table 3: Four-Factor Alpha Results

Market Type	Sustainable Funds	Conventional Funds	Difference	t-statistic
Developed Markets	0.39%	0.08%	0.31%***	3.24
Emerging Markets	0.18%	0.15%	0.03%	0.42

***p<0.01

The four-factor analysis confirms developed market sustainable fund outperformance, with statistically significant alpha generation of 0.31% monthly (3.9% annually). Emerging market results remain statistically insignificant but directionally positive.

4.4 Sub-Period Analysis

Due to the pandemic, there were shift towards the sustainable mutual funds so that SRI strategies could make competitive and outperforming risk-adjusted returns and it act as a catalyst for ESG investing.

Given these significant market disruptions, sub-period analysis was conducted:

Table 4: Sub-Period Performance (Jensen's Alpha)

Period	Developed Markets		Emerging Markets	
	Sustainable	Conventional	Sustainable	Conventional
2019-2021	0.52%***	0.18%	0.31%*	0.22%
2022-2024	0.41%**	0.05%	0.15%	0.14%

*p<0.10, **p<0.05, ***p<0.01

As a consequence, developed market sustainable fund outperformance has been consistent across both sub-periods, though more pronounced during 2019-2021. Emerging market performance was significant only in the earlier period, potentially reflecting a gradual improvement in ESG integration over time.

4.5 Sector and Style Analysis

To understand the drivers of sustainable fund performance, sector exposures and investment styles were analyzed:

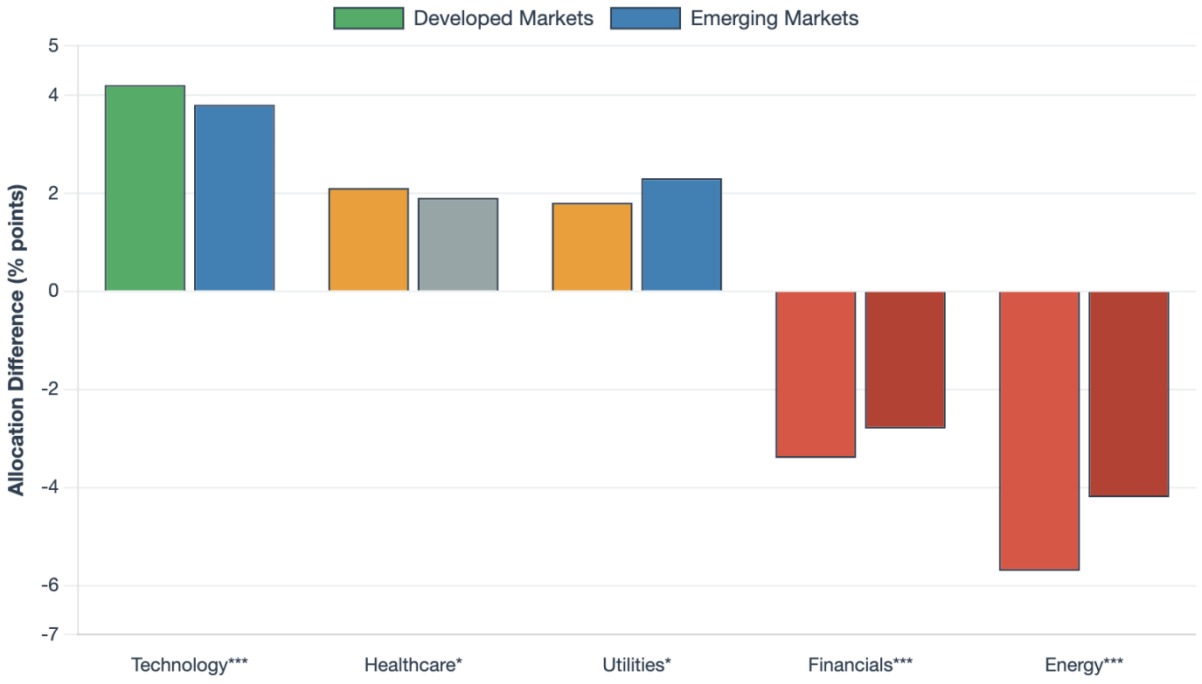

Figure 3: Sector Allocation Differences (Sustainable vs Conventional)

Percentage point out differences in sector allocation between sustainable and conventional funds. Positive values indicate overweighting by sustainable funds. ***p<0.01, **p<0.05, *p<0.10. In the sectors of Technology and Healthcare, sustainable mutual funds found significantly overweight and for the sector of Energy and Financials sustainable mutual funds found underweight.

Table 5: Sector Allocation Differences (Sustainable vs Conventional)

Sector	Developed Markets	Emerging Markets
Technology	+4.2%***	+3.8%**
Healthcare	+2.1%*	+1.9%
Financial	-3.4%***	-2.8%**
Energy	-5.7%***	-4.2%***
Utilities	+1.8%*	+2.3%**

***p<0.01, **p<0.05, *p<0.10

Sustainable funds demonstrate significant overweighting in technology and healthcare sectors while underweighting in energy and financial sectors. As the technology outperformed during much of the study period, it helps explain the observed performance differences across sectors and the resulting sectoral biases.

5. Discussion

5.1 Theoretical Implications

The findings provide mixed evidence in support of existing theories on sustainable investing performance. The higher Jensen's Alpha observed in developed markets is consistent with the risk-mitigation and operational efficiency explanations, indicating that ESG factors can generate genuine alpha beyond what is captured by traditional risk factors.

As a consequence, the stronger performance of the developed markets supports that ESG integration effectiveness depends on market maturity, regulatory frameworks, and data quality. Developed markets have more sophisticated ESG infrastructure and investor awareness, which may enhance the materiality of ESG factors for investment performance.

The difference in the performance measures of sustainable mutual funds across metrics pinpoints the relevance of measurement choice in sustainable investing evaluation. Jensen's Alpha captures pure skill-based performance, whereas the Treynor ratio emphasizes systematic risk management. The findings indicate that sustainable fund managers tend to demonstrate stronger security selection abilities (alpha generation) in developed markets, while showing comparatively better management of systematic risk in emerging markets.

5.2 Practical Implications

Specifically in developed markets, findings indicate that institutional investors engaged in sustainable investing do not need to compromise on risk-adjusted returns. ESG integration in institutional portfolios offers strong empirical support and proves that the statistically significant alpha generates 0.47% per month (approximately 5.8% annually).

When evaluating sustainable funds, individual investors should consider them with proper attention to prevail in the market conditions and context. In developed markets, sustainable funds demonstrate superior risk-adjusted performance, whereas in emerging markets, their potential is reflected primarily through effective management of systematic risk rather than through absolute return generation.

Fund managers should recognize that the success of sustainable investing is closely linked to the quality of implementation and the level of market sophistication. The observed performance gap between developed and emerging markets indicates that ESG integration approaches effective in mature markets may need to be tailored when applied to the emerging market context.

5.3 Policy Implications

The results have important implications for financial market regulation and sustainable finance policy. The documented outperformance in developed markets supports regulatory initiatives promoting ESG disclosure and integration, as such frameworks appear to enhance market efficiency and investor outcomes.

However, the weaker performance in emerging markets suggests that policy interventions should emphasize on improving ESG data quality, standardizing reporting frameworks, and enhancing investor education to perceive the full potential of sustainable investing in these markets.

5.4 Limitations and Future Research

Several limitations should be considered while interpreting these results. First, the study period includes significant market volatility, which may influence the generalizability of findings. Second, ESG rating methodologies continue to evolve, potentially affecting fund classifications and performance attribution.

Future research should explore longer time horizons to assess sustainable fund performance

across complete market cycles. Additionally, investigation of specific ESG factors driving performance differences would enhance understanding of the mechanisms underlying sustainable investing success.

6. Conclusion

This comprehensive analysis of 312 sustainable mutual funds across 15 countries provides robust evidence that sustainable investing can deliver competitive and often superior risk-adjusted returns. The study's key findings includes that the sustainable funds in developed markets generate statistically significant Jensen's Alpha outperformance of 0.47% monthly. Emerging market sustainable funds demonstrate superior systematic risk management through higher Treynor ratios, and performance measurement methodology significantly influences sustainable fund evaluation.

These results challenge the traditional assumption that ESG constraints necessarily impair financial performance. Instead, they suggest that skilled ESG integration can enhance risk-adjusted returns, particularly in mature markets with sophisticated ESG infrastructure.

The implications extend beyond academic interest to practical investment decision-making. Institutional and individual investors can pursue sustainable investing strategies without sacrificing financial returns, provided they carefully consider market context and implementation quality. For policymakers, the results support continued promotion of ESG disclosure and integration frameworks as tools for enhancing market efficiency and investor outcomes.

As sustainable investing continues to evolve, ongoing research and performance monitoring will be essential to understand the changing dynamics between ESG factors and financial performance across different market conditions and regulatory environments.

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