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Analysis of the Hedge and Safe Haven Properties of the ISE B3: Perspectives for Local and Global Investors

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ABSTRACT

This paper investigates whether Brazil's Corporate Sustainability Index (ISE B3) exhibits hedge, safe haven, or diversifier properties against the domestic market and international benchmarks. Using daily USD data from December 2005 to March 2026 ($n = 5{,}086$ log returns), the study applies three complementary methodologies: EGARCH(1,1) with Student-t distribution for asymmetric conditional volatility modeling; the formal Baur and Lucey (2010) test via HAC-robust OLS with quantile interaction terms; and Monte Carlo portfolio optimization with the Markowitz efficient frontier. Results show the ISE fails as a hedge or safe haven in all scenarios analyzed, with correlation with the Ibovespa exceeding 0.90 and classification as a diversifier against all six benchmarks investigated. Markowitz analysis confirms the ISE does not expand the global efficient frontier (daily return falls from 0.03865% to 0.03787% with nearly identical risk). Findings consistently show that in Brazil, systematic country risk dominates ESG factor benefits for portfolio protection purposes.

1. Introduction

The global financial landscape is marked by recurrent crises and high interconnectedness. In this context, investors seek assets that protect capital during turbulent periods. The recent literature has expanded this search beyond traditional assets, such as gold and government bonds, investigating the role of alternative and thematic assets in building resilient portfolios. Bouri and Roubaud (2016) showed how exotic assets, such as fine wines, can decorrelate portfolios during periods of stress. In parallel, the rise of ESG (Environmental, Social and Governance) criteria and of thematic sector indices has opened a new horizon of debate on the use of sustainable indices in portfolio protection and composition.

Brazil's Corporate Sustainability Index (ISE B3) was created in 2005, inspired by the Dow Jones Sustainability Index, and represents the first Latin American initiative to measure the performance of companies committed to good ESG practices. Since then, the growth of sustainable investing in Brazil and worldwide has placed the ISE at the center of the debate on the compatibility between financial profitability and corporate responsibility. This growth, however, contrasts with ambiguous evidence in emerging markets. Pisera and Chiappini (2024) observed, in China, that the country's systematic risk may overshadow the diversification benefits of ESG assets; Rubbaniy et al. (2022) found a similar result in the Arab region, where correlation with the broad market often prevents effective portfolio protection.

Against this backdrop of uncertainty, the central problem of this research is to investigate whether the ISE B3 acts as a hedge or safe haven instrument, or whether its movements maintain a structural dependence on the domestic market (Ibovespa). Additionally, the study examines the suitability of the ISE as a diversifier in a global context, contrasting its effectiveness with that of alternative international assets, such as PHO. The general objective is to analyze the hedge, diversifier, and safe haven properties of the ISE B3 between December 2005 and March 2026, using daily USD data, contrasting its effectiveness for investors exposed to Brazil risk versus global investors. The specific objectives are: (a) to estimate the conditional volatility of the assets using the EGARCH(1,1)-t, capturing asymmetry and the leverage effect; (b) to classify the ISE according to Baur and Lucey (2010) via HAC-robust OLS regression with quantile interaction terms; and (c) to verify whether the inclusion of the ISE improves the efficient frontier of portfolios through Monte Carlo simulation.

Based on the emerging-market literature and portfolio theory, two hypotheses are tested, with the international scenario treated as a robustness check. The null hypothesis (H0) states that the ISE B3 does not act as a protective asset relative to the Ibovespa, with a positive and statistically significant conditional correlation in both normal and financial-stress periods. The alternative hypothesis (H1) states that the ISE acts as a protective asset, with a null or negative conditional correlation in normal periods (hedge) and/or in the extreme percentiles of market decline (safe haven).

The study covers daily data from December 2005 to March 2026, totaling 5,086 logarithmic returns, a period that captures four distinct crisis cycles: the 2008 Subprime Crisis, the 2014–2016 Brazilian Domestic Crisis, the 2020 COVID-19 pandemic, and the subsequent instability of global markets between 2022 and 2026. All series were standardized in U.S.

Dollars (USD) to eliminate exchange-rate distortions. The research empirically tests whether the so-called "sustainability premium" in Brazil translates into real financial protection, and contributes to the literature by jointly applying the Baur and Lucey (2010) framework and the Markowitz efficient frontier to the ISE B3 at a daily frequency, an approach still little explored in the Brazilian literature.

The paper is organized into six sections. Section two presents the literature review; section three sets out the theoretical framework; section four describes the data, sample, and econometric procedures; section five presents and discusses the empirical results; and section six offers concluding remarks.

2. Related Literature

The literature on hedge and safe haven assets in finance was systematized by Baur and Lucey (2010), whose seminal article established the operational definitions widely adopted today. The authors investigated gold as a protective asset relative to stocks and bonds in developed markets, concluding that the precious metal acts as a safe haven during extreme stress periods, but not as a permanent hedge. This framework has become the predominant methodological reference in the field.

In the ESG literature, the debate on protective properties has gained increasing relevance. Pedini and Severini (2025) investigated ESG indices in European markets and concluded that, although they exhibit diversifier characteristics, they rarely achieve hedge or safe haven status, owing to their high correlation with broad market indices. The authors stress that investors frequently overestimate the protective potential of sustainable assets, especially during systemic crises.

For emerging markets, the picture is even less favorable to the ESG-protection hypothesis. Pisera and Chiappini (2024) analyzed ESG indices in China during the COVID-19 pandemic and showed that the country's systematic risk dominates ESG-factor benefits during extreme stress, using dynamic conditional correlation (DCC) models. Rubbaniy et al. (2022) examined ESG assets in Arab countries during the pandemic and reached similar conclusions: correlation with the broad market remained high and positive even at the worst moments of the crisis, ruling out classification as a safe haven. The authors attribute this result to the sectoral concentration of ESG indices in these markets, which largely replicate the composition of conventional indices.

In the Brazilian equity market, the specific literature on the ISE B3 as a portfolio-protection instrument is still scarce. Bouri and Roubaud (2016), analyzing alternative assets in developed markets, documented that assets with lower structural correlation with the broad market can play relevant diversification roles even without achieving formal hedge status, which motivates the investigation of thematic indices such as the ISE in emerging contexts. Methodologically, estimating EGARCH models to capture volatility asymmetry in daily financial series is widely recommended: Nelson (1991) showed that the EGARCH outperforms the symmetric GARCH in equity markets, and Bollerslev (1987) and Engle (1982, 2001) established the foundations of GARCH modeling with heavy-tailed distributions, validating the use of the Student-t distribution for daily returns.

In sum, the literature review points to three gaps that this research seeks to fill: (i) the absence of studies on the ISE B3 at a daily frequency using the Baur and Lucey (2010) framework; (ii) the systematic comparison of the ISE with multiple global benchmarks, including emerging and developed markets; and (iii) the integration of protection analysis with portfolio optimization via the Markowitz efficient frontier for the Brazilian context.

3. Theoretical Framework

3.1. Modern Portfolio Theory

Contemporary investment management is grounded in Modern Portfolio Theory (MPT), introduced by Markowitz (1952). The central innovation was to formalize mathematically the concept of diversification: by combining assets with imperfect correlations, a rational investor can build a portfolio whose total risk is lower than the weighted average of the individual risks, without sacrificing expected return. MPT establishes that, for any desired level of return, there is a portfolio composition that minimizes risk, and the set of these compositions forms the Efficient Frontier. The ratio between return and risk (standard deviation) is the standard metric for comparing the efficiency of compositions: the higher this ratio, the more return the portfolio offers per unit of risk assumed. Bouri and Roubaud (2016) demonstrated that exotic assets can provide effective protection against equity-market movements; this research applies the same logic by investigating whether ESG and thematic indices can act similarly within domestic and global portfolios.

3.2. Definitions of Diversifier, Hedge, and Safe Haven

To classify asset behavior, this study adopts the formal definitions of Baur and Lucey (2010): (a) Diversifier: an asset with a positive but not perfect correlation with the market portfolio under normal conditions; (b) Hedge: an asset that exhibits a null or negative correlation with the market portfolio under normal conditions (on average over the period); (c) Safe Haven: an asset that maintains a null or negative correlation specifically during periods of turbulence and extreme financial stress. The operational distinction has direct implications for strategic allocation: a hedge is held permanently in light of its average correlation with the market, whereas a safe haven is valued especially for the protection it offers during extreme systemic stress.

3.3. ESG and Value Protection in Emerging Markets

The relationship between sustainability (ESG) and financial performance has been widely debated. The central hypothesis is that companies committed to ESG practices would be more resilient to long-term risks, which would translate into lower volatility and greater value stability during crises. An emblematic example in the Brazilian market is that of Vale: the collapse of the Brumadinho dam in January 2019 caused substantial negative abnormal returns in the company's shares (Fogaça et al., 2023; Silva and Barros, 2023) and led to its exclusion from the ISE B3 portfolio, in which it was then the largest holding. The episode illustrates how failures in socio-environmental criteria can translate into material financial and reputational losses.

In the Brazilian context, the ISE composition predominantly includes large-capitalization companies that are also part of the Ibovespa, which raises, a priori, doubts about the degree of structural decorrelation the index can offer the local investor. A few blue chips — notably Vale, Petrobras, and the large banks — account for about half of the Ibovespa portfolio (B3 — Brasil, Bolsa, Balcão, 2026), and these same companies are, for the most part, in the ISE. Since Vale and Petrobras alone have accounted for more than a quarter of the broad index, changes in their positions — such as Vale's exit after Brumadinho — alter the relationship between the two indices over time, which warrants caution in generalizing the results.

3.4. Conditional Volatility Model: EGARCH

The modeling of financial returns faces the phenomenon of conditional heteroskedasticity, in which volatility clusters in periods of high and low values — the so-called volatility clustering, documented by Mandelbrot (1963) and formalized by Engle (1982) with the ARCH model. Bollerslev (1986) generalized the model to the GARCH(1,1), and Nelson (1991) proposed the EGARCH (Exponential GARCH), which extends the GARCH(1,1) to capture the asymmetry of volatility shocks. In the EGARCH, the conditional variance equation is specified in logarithms:

$$\ln(h_t^2) = \omega + \alpha_1 \left(\left| \frac{\varepsilon_{t-1}}{h_{t-1}} \right| - E \left| \frac{\varepsilon_{t-1}}{h_{t-1}} \right| \right) + \gamma_1 \frac{\varepsilon_{t-1}}{h_{t-1}} + \beta_1 \ln(h_{t-1}^2) \tag{1}$$

where h_t^2 is the conditional variance at time t; ω is the intercept; α_1 captures the impact of past shocks on current volatility (ARCH effect); γ_1 is the asymmetry coefficient capturing the leverage effect (if $\gamma_1 < 0$, negative shocks amplify volatility more than positive shocks of the same magnitude); β_1 is the persistence coefficient (values close to 1 indicate high persistence); $\varepsilon_{t-1}/h_{t-1}$ is the standardized residual of the previous period; and ν is the number of degrees of freedom of the Student-t distribution (low values indicate heavy tails). The logarithmic specification ensures a positive conditional variance without additional parametric restrictions (Bollerslev, 1987; Nelson, 1991).

4. Data and Methodology

4.1. Research Design and Data

This research is classified as quantitative, using statistical and econometric methods to test market hypotheses. As to its purpose, it is descriptive and explanatory: it characterizes the volatility and correlation behavior of the assets and seeks to explain whether the ISE functions as a protection or refuge instrument in domestic and global portfolios. The sample comprises daily adjusted-closing data from December 8, 2005, to March 6, 2026, totaling 5,087 raw observations, reduced to 5,086 logarithmic returns after first differencing.

The assets analyzed are: (a) ISE B3 (USD), the central object of the research; (b) IBOV (USD), a proxy for the domestic market; (c) SPY (SPDR S&P 500 ETF Trust); (d) PHO (Invesco Water Resources ETF); (e) EEM (iShares MSCI Emerging Markets ETF); (f) VGK (Vanguard FTSE Europe ETF); and (g) FXI (iShares FTSE China 50 ETF). The Brazilian series (ISE and IBOV) were converted to USD using the daily PTAX rate, obtained from Ipeadata; the B3 data were extracted from the index's official database; and the international ETFs were collected via Yahoo Finance. Missing values on Brazilian business days without a counterpart in international markets were treated by linear time interpolation (Tsay, 2010; Rubin, 1976), resulting in a balanced panel with 5,086 valid daily observations for all assets.

4.2. Econometric Procedures

Prices were transformed into continuous logarithmic returns (in percentages):

$$r_t = 100 \times \ln(P_t / P_{t-1}) \tag{2}$$

where r_t is the logarithmic return at time t (in %) and P_t is the adjusted closing price at time t. Normality was assessed using the Jarque-Bera test, and for each asset the EGARCH(1,1)-t model was estimated (Nelson, 1991; Bollerslev, 1987). The choice of the EGARCH over the symmetric GARCH(1,1) is justified by the documented presence of the leverage effect in equity returns. The two econometric stages are sequential and complementary: the EGARCH estimation serves a diagnostic function — it characterizes the dynamics of conditional volatility, asymmetry, and persistence, confirming the stylized facts that justify the use of the Student-t distribution — and precedes the Baur and Lucey (2010) test, which directly assesses the hedge and safe haven properties. Formally, the non-rejection of H0 corresponds to $c_1 > 0$ and $\text{Slope}_{q01} > 0$ (diversifier), whereas H1 would require $c_1 \leq 0$ (hedge) and/or $\text{Slope}_{q01} \leq 0$ (safe haven).

For the Baur and Lucey (2010) test, the following HAC-robust OLS regression (Newey-West, 3 lags) is estimated for each benchmark b:

$$r_{\mathrm{ISE},t} = c_0 + c_1\, r_{b,t} + c_2\, D_{q10,t} + c_3\, D_{q5,t} + c_4\, D_{q1,t} + \varepsilon_t \tag{3}$$

where $r_{\mathrm{ISE},t}$ and $r_{b,t}$ are the returns of the ISE and of benchmark b at time t; c_1 is the average sensitivity of the ISE in normal periods (if $c_1 \leq 0$, it is classified as a hedge); D_{q10}, D_{q5}, and D_{q1} are interaction terms that take the value of the benchmark return when it is in the 10%, 5%, and 1% most negative percentiles (and zero otherwise); and the total slope in the most extreme percentile is given by $c_1 + c_2 + c_3 + c_4$ (Slope_{q01}), so that, if $\mathrm{Slope}_{q01} \leq 0$, it is classified as a safe haven. The choice of the 10%, 5%, and 1% percentiles follows the original protocol of Baur and Lucey (2010). The Markowitz efficient frontier was estimated via Monte Carlo with 10,000 portfolios generated by a Dirichlet distribution (weights summing to one, no short selling), at a daily frequency, simulating three scenarios: (i) a local portfolio with ISE and IBOV; (ii) a global portfolio without ISE; and (iii) a global portfolio with ISE.

5. Results

This section presents the results of the three analytical stages: (i) statistical diagnostics and the EGARCH(1,1)-t; (ii) the Baur and Lucey (2010) test; and (iii) the Markowitz efficient frontier.

5.1. Statistical Diagnostics and EGARCH(1,1)-t Estimation

Table 1 summarizes the results of the statistical diagnostics and the EGARCH estimation for the assets analyzed.

Table 1. Statistical Diagnostics and EGARCH(1,1)-t Estimation — Dec/2005 to Mar/2026

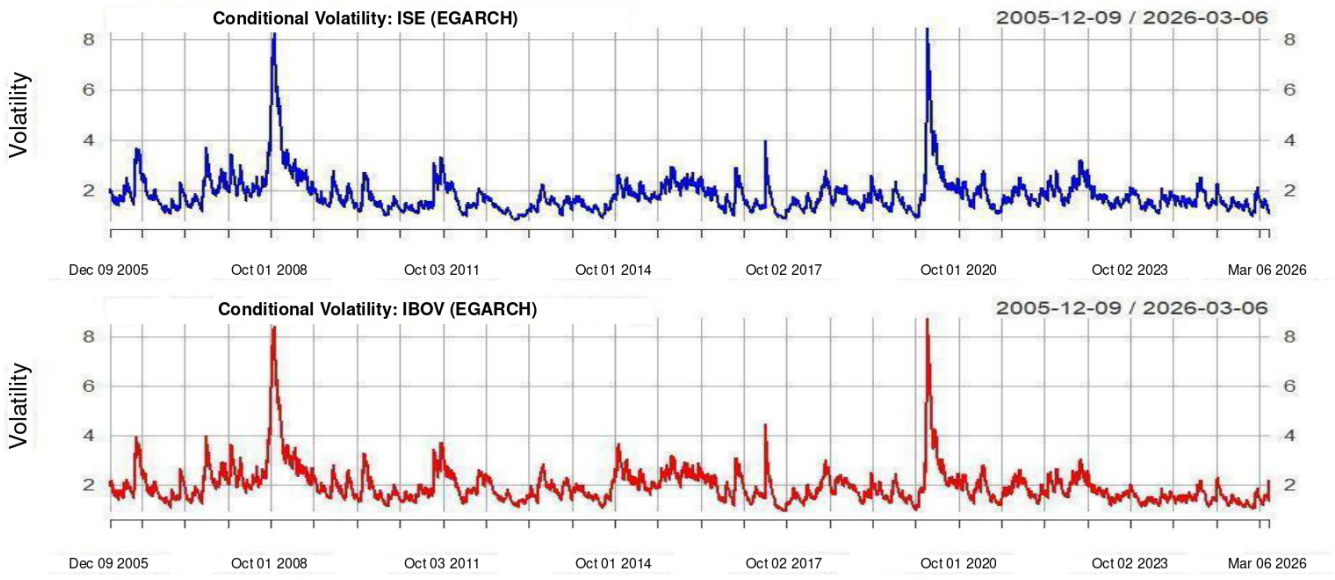
Asset	N	Mean (%)	Std.Dev. (%)	Skew.	μ	ω	γ_1	β_1	ν
ISE B3	5,086	0.0132	2.0563	neg.	0.0417	0.0192	−0.0629	0.9820	7.96
IBOV	5,086	0.0165	2.1759	neg.	0.0449	0.0223	−0.0637	0.9815	7.37
SPY	5,086	0.0403	1.2052	neg.	0.0715	−0.0125	−0.1927	0.9756	4.78
PHO	5,086	0.0321	1.4595	neg.	0.0534	0.0017	−0.1102	0.9861	7.38
EEM	5,086	0.0219	1.7310	pos.	0.0472	0.0087	−0.0913	0.9834	6.86
VGK	5,086	0.0239	1.4543	neg.	0.0569	0.0009	−0.1065	0.9843	5.76
FXI	5,086	0.0199	2.0828	pos.	0.0336	0.0163	−0.0462	0.9861	5.63

Note: Daily log returns (×100), USD. N = 5,086 obs. EGARCH(1,1)-t estimated for the 7 assets. γ_1 = Nelson (1991) asymmetry coefficient: $\gamma_1 < 0$ indicates the leverage effect. Magnitude (α) and persistence (β) coefficients per asset — ISE: $\alpha = 0.1349$, $\beta = 0.9820$; IBOV: $\alpha = 0.1320$, $\beta = 0.9815$; SPY: $\alpha = 0.1631$, $\beta = 0.9756$; PHO: $\alpha = 0.1271$, $\beta = 0.9861$; EEM: $\alpha = 0.1559$, $\beta = 0.9834$; VGK: $\alpha = 0.1506$, $\beta = 0.9843$; FXI: $\alpha = 0.1545$, $\beta = 0.9861$. EEM and FXI show positive skewness; the other assets, negative skewness. All: excess kurtosis (Jarque-Bera $p \approx 0$).

Source: prepared by the authors (2026).

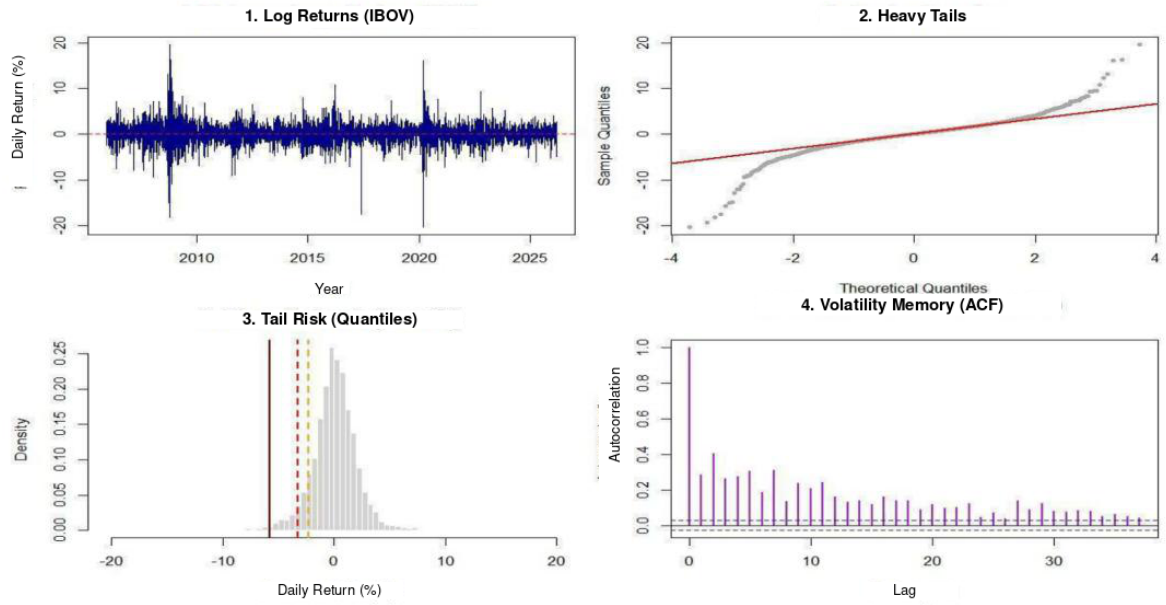
The Jarque-Bera test yields a p-value of approximately zero for all seven assets, indicating statistically significant excess kurtosis. Skewness is negative for the ISE B3, IBOV, SPY, PHO, and VGK, and positive for the EEM and FXI, a pattern that confirms the need for heavy-tailed distributions and validates the Student-t distribution in the EGARCH. Figures 1 and 2 present, respectively, the estimated conditional volatility for the ISE B3 and the IBOV, and the statistical diagnostics of the IBOV returns.

Figure 1. Conditional EGARCH Volatility: ISE B3 (blue) and IBOV (red) — Dec/2005 to Mar/2026



Source: prepared by the authors (2026).

Figure 2. Statistical Diagnostics: IBOV Returns (histogram, QQ-plot, tail distribution, and volatility ACF)



Source: prepared by the authors (2026).

The EGARCH(1,1)-t converged for all seven assets with well-behaved parameters. The persistence $\beta_1 = 0.9815$ for the IBOV indicates that volatility shocks dissipate slowly, a pattern documented in the literature on emerging markets in daily data (Engle, 2001). The asymmetry parameter $\gamma_1 = -0.0637 < 0$ for the IBOV confirms the leverage effect, in line with Nelson (1991). An analogous result is observed for all other assets in the sample ($\gamma_1 < 0$ in all cases, Table 1), most notably for the S&P 500 ($\gamma_1 = -0.1927$), the strongest effect in the sample.

5.2. Formal Hedge and Safe Haven Test: Baur and Lucey (2010)

The coefficients estimated by the Baur and Lucey (2010) framework are presented in Table 2.

Table 2. Baur and Lucey (2010): ISE B3 Classification — HAC-robust OLS, Newey-West (lags = 3)

Benchmark	c_1	Slope$_{q10}$	Slope$_{q05}$	Slope$_{q01}$	Classification
IBOV (local)	0.9055	0.8976	0.9075	0.9386	DIVERSIFIER
S&P 500 (SPY)	0.9511	0.7491	1.0264	1.1552	DIVERSIFIER
PHO Water	0.7414	0.7973	0.7565	1.0449	DIVERSIFIER
EEM (Emerg.)	0.7868	0.8264	0.8534	0.8472	DIVERSIFIER
VGK (Europe)	0.8350	0.8573	0.8183	0.9454	DIVERSIFIER
FXI (China)	0.4726	0.5087	0.5480	0.6521	DIVERSIFIER

Note: Dependent variable: daily ISE B3 returns (USD). c_1 = average slope of the ISE on the benchmark in normal periods. Slope$_{qx}$ = total slope of the ISE on the benchmark when the benchmark returns are in the x most negative percentile (= c_1 + sum of interaction terms up to qx). Hedge: $c_1 \leq 0$. Safe Haven: Slope$_{q01} \leq 0$. All c_1 are positive and significant ($p < 0.001$); all Slope$_{q01}$ are positive.

Source: prepared by the authors (2026).

The c_1 coefficient is positive and highly significant ($p < 0.001$) for all six benchmarks, ruling out the hedge property in any scenario. The average sensitivity of the ISE to the Ibovespa ($c_1 = 0.9055$) confirms the null hypothesis H0: the ISE shows structural integration with the domestic market. This result is explained by the compositional overlap between the two indices, since the ISE companies are, to a large extent, the same blue chips as the Ibovespa, making the ESG criterion insufficient to decorrelate the portfolio from Brazilian systematic risk.

The high sensitivity of the ISE to the S&P 500 ($c_1 = 0.9511$) reflects the strong co-movement between the Brazilian and U.S. markets, amplified by the exchange-rate effect on the USD-denominated series, replicating for Brazil the pattern documented by Pisera and Chiappini (2024) and Rubbaniy et al. (2022). The ISE is also classified as a diversifier relative to the Chinese market ($c_1 = 0.4726$, Slope$_{q01} = 0.6521 > 0$): although c_1 relative to the FXI is the lowest in the sample — reflecting the absence of direct transmission channels between the Brazilian and Chinese financial systems — the total slope in the 1% most negative percentile remains positive, precluding classification as a safe haven.

5.3. Markowitz Efficient Frontier

Table 3 compares the portfolios with the best return/risk ratio in the three simulated scenarios; Figure 3 presents the cloud of portfolios for the global scenarios.

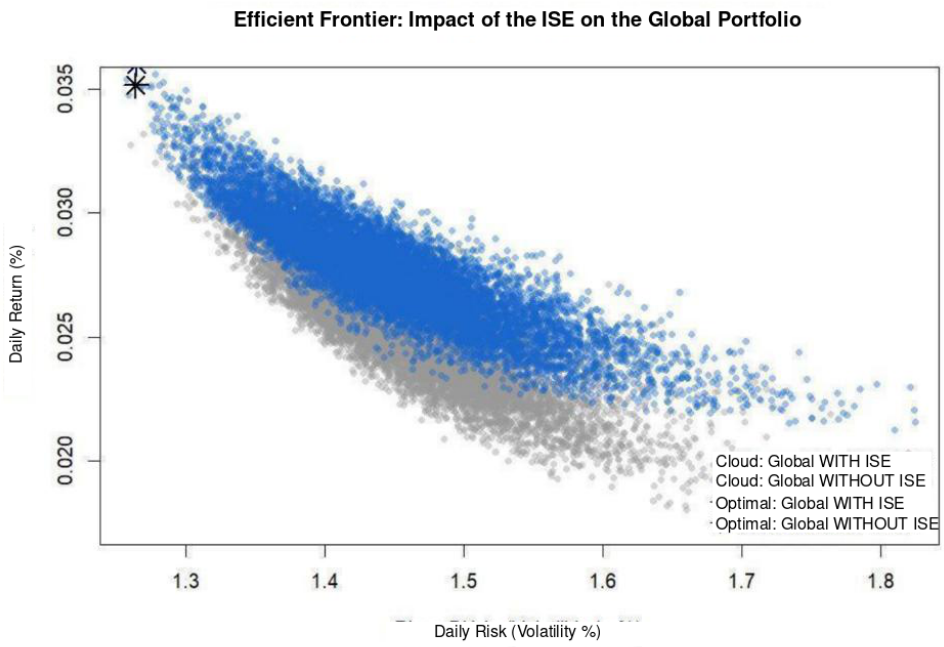
Table 3. Markowitz Efficient Frontier: Portfolios with the Best Return/Risk Ratio

Scenario	Daily Return (%)	Daily Risk (%)	Ret./Risk
Local: ISE + IBOV	0.01646	2.1761	0.00756
Global without ISE	0.03865	1.2251	0.03155
Global with ISE	0.03787	1.2332	0.03070

Note: Monte Carlo with 10,000 portfolios, Dirichlet weights (no short selling). Return and risk at a daily frequency (%). The "Global without ISE" portfolio dominates the "Global with ISE" portfolio: higher daily return (0.03865% vs 0.03787%) and marginally lower risk (1.2251% vs 1.2332%), confirming that the inclusion of the ISE deteriorates both dimensions of the efficient frontier.

Source: prepared by the authors (2026).

Figure 3. Markowitz Efficient Frontier: Impact of the ISE on the Global Portfolio (gray = with ISE; blue = without ISE)



Source: prepared by the authors (2026).

The return (0.01646% per day) and risk (2.176% per day) of the local ISE + IBOV portfolio are practically identical to a portfolio formed solely by the IBOV, a direct consequence of the coefficient $c_1 = 0.9055$ between the two assets: any combination of ISE and Ibovespa converges to the same attributes as the pure IBOV, with no quantifiable benefit in holding the ISE in domestic portfolios for purely financial reasons.

Adding the ISE to the global portfolio reduces the daily return from 0.03865% to 0.03787% while risk increases marginally (from 1.2251% to 1.2332% per day), simultaneously deteriorating both dimensions of the efficient frontier. The ISE does not contribute to expanding the global efficient frontier, since its high co-movement with the emerging-market index (EEM: $c_1 = 0.7868$) and the S&P 500 (SPY: $c_1 = 0.9511$) implies no significant incremental diversification. The global scenario without the ISE shows the best absolute performance (return = 0.03865% per day; risk = 1.2251% per day), substantially higher than the local portfolio, confirming that, among the seven assets analyzed, international diversification was the most effective risk-reduction strategy for the Brazilian investor. The three sets of evidence converge: the null hypothesis H0 is not rejected — the ISE does not act as a hedge or safe haven for the local investor.

6. Concluding Remarks

This research investigated the hedge and safe haven properties of the ISE B3 using daily USD data from December 2005 to March 2026, combining the EGARCH(1,1)-t, the formal Baur and Lucey (2010) test, and portfolio optimization via Monte Carlo. The results consistently indicate that the ISE B3 functions neither as a hedge nor as a safe haven in any of the scenarios analyzed and for none of the six benchmarks investigated.

The EGARCH analysis revealed high persistence of the IBOV's conditional volatility ($\beta_1 = 0.9815$) and the presence of a leverage effect ($\gamma_1 = -0.0637 < 0$), confirming the suitability of the asymmetric specification for daily data in emerging markets. The leverage effect was confirmed for all seven assets in the sample. The conditional-volatility chart clearly documents the peaks associated with the Subprime Crisis (2008), the Brazilian Domestic Crisis (2014–2016), the COVID-19 pandemic (2020), and the recent instability (2022–2026).

The Markowitz analysis confirms that international diversification was, among the seven assets analyzed, the most effective risk-reduction strategy for the Brazilian investor (daily return of 0.03865% with risk of 1.23%), substantially

higher than the local portfolio (return of 0.01646% with risk of 2.18%). Including the ISE in the global portfolio marginally reduces return without any compensation in risk, confirming the absence of measurable financial gain.

From a practical standpoint, ESG-mandated managers who replace the Ibovespa with the ISE in local portfolios should not expect quantifiable risk-reduction benefits. For global investors, the ISE shows the lowest co-movement with China ($c_1 = 0.4726$), suggesting some potential for structural diversification in this specific pair, but insufficient to achieve safe haven properties. As a limitation, the analysis does not include dynamic correlations by crisis subperiod; future research could implement the full formal DCC (Engle, 2002), incorporate subperiod analysis with rolling windows, and investigate whether the findings hold as the sample is extended beyond 2026. This paper contributes to the literature by applying the Baur and Lucey (2010) framework to the ISE B3 at a daily frequency, a combination still little explored in the Brazilian literature on ESG assets.

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