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International Portfolio Diversification with ETFs, BDRs, and FIAs: Evidence for Brazilian Investors

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Abstract

Objective: To comparatively analyze the potential benefits of international diversification, in terms of risk-adjusted returns, through Exchange Traded Funds (ETFs), Brazilian Depositary Receipts (BDRs), and equity investment funds (FIAs) with foreign allocations from the perspective of Brazilian investors.
Method: Cointegration tests were conducted between the series of the logarithm of daily Ibovespa prices and the domestic asset classes with exposure to foreign markets under analysis. In addition, theoretical portfolios were created to analyze whether the inclusion of domestic assets with exposure to foreign markets could improve the risk-adjusted return of the portfolios.
Results: The results show that few assets maintain a stable long-term relationship with Ibovespa, suggesting advantages of international diversification for Brazilian investors. The improvement in risk-adjusted returns varies depending on the different asset classes, the scenario (with or without a risk-free rate), due to the diversification strategies and the cointegration test applied. Thus, investors who manage their portfolios more passively can improve their performance by adding ETFs and FIAs to their portfolios, and for those who prefer to select their assets individually, BDRs have proven to be an interesting option.
Contributions: The results contribute to the creation of investment strategies that aim for an efficient international portfolio, especially for individual investors, for whom transaction costs and other potential barriers could hinder the realization of the benefits of international diversification.

Keywords: Portfolio Diversification; Cointegration; ETF; BDR; FIA.

How to Cite:

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Introduction

Since Markowitz's seminal work (1952), research has focused on developing asset allocation models to optimize the performance of investment portfolios by considering different asset classes (Lewin & Campani, 2020). Furthermore, diversification is also advantageous for mitigating some of the risk inherent in a given asset (Sharpe, 1964).

Among the possibilities for diversification, it is worth considering the potential benefits of exposure to assets from different geographies (Bányai et al., 2025). These benefits stem primarily from the mitigation of market, political, and inflationary risks (Attig et al., 2023). However, investing in foreign markets presents some potential barriers, in addition to additional transaction costs (Errunza et al., 1999), although such costs have decreased substantially in recent decades (Lee et al., 2023). As an alternative, there are domestic assets with exposure to foreign markets (Miralles-Quirós et al., 2019), which offer a convenient and cost-effective method of reaping the benefits of international diversification (O'Hagan-Luff & Berrill, 2019).

In the international literature, there is evidence of diversification benefits across certain asset classes, as demonstrated by Enrrunza et al. (1999) and Lu and Vivian (2020) for mutual funds and American Depository Receipts (ADRs), and by Bányai et al. (2025), Li and Jiang (2025), and Han (2025), for Exchange-Traded Funds (ETFs). In the Brazilian context, the topic was addressed by Borges and Malaquias (2017), who evaluated mutual funds with foreign stocks and Brazilian Depositary Receipts (BDRs); and by Grossi and Malaquias (2019), who also evaluated mutual funds.

However, in addition to BDRs and equity investment funds (FIAs), Brazilian investors have ETFs as a domestic asset option with exposure to foreign stock markets. It is also worth noting that the Brazilian Securities and Exchange Commission (SEC) introduced, through Resolution No. 03/2020, a series of changes to the markets for these assets, a development that has facilitated access and fostered the growth of these investment vehicles. In this regard, there is a gap in the national literature regarding the analysis of the potential benefits of international diversification through ETFs, as has been done, from the perspective of other markets, by Errunza et al. (1999), Tsai and Swanson (2009), Miralles-Marcelo et al. (2015), Miralles-Quirós et al. (2019), O'Hagan-Luff and Berrill (2015, 2019), Bányai et al. (2025), Li and Jiang (2025), and Han (2025).

In this context, the following research question is formulated: what is the impact, in terms of risk-adjusted return, of including domestic assets with exposure to foreign markets—ETFs, BDRs, and FIAs—in equity portfolios from the perspective of Brazilian investors? Thus, the objective of this study is to comparatively analyze the potential benefits of international diversification, in terms of risk-adjusted returns, through ETFs, BDRs, and FIAs with overseas allocations from the perspective of Brazilian investors.

To this end, daily data on prices and returns for the Ibovespa, as well as for ETFs, BDRs, and FIAs (with at least 25% allocated overseas), were analyzed from January 4, 2021, to June 12, 2023, totaling 977 assets and 607 trading days. A methodology similar to that of Guidi and Ugur (2014) was used, beginning with the cointegration tests of Johansen (1988) and Johansen and Joselius (1990) to verify the long-term relationship between Brazilian stocks and assets with foreign exposure. Furthermore, theoretical portfolios were created using two diversification strategies to assess the impact of including domestic assets with international exposure on risk-adjusted returns, considering scenarios with and without a risk-free rate.

The main findings reveal a low proportion of assets that exhibited a stable long-term relationship with the Ibovespa. This supports the idea that it is possible for a Brazilian investor to obtain benefits from international diversification, in terms of risk-adjusted returns, through the domestic asset classes analyzed. However, the improvement in risk-adjusted returns varies depending on the different asset classes, the scenario (with or without a risk-free rate), due to the diversification strategies and the cointegration test applied.

Academically, the study expands the literature on international portfolio diversification, particularly from the perspective of a developing country like Brazil. Furthermore, in addition to the previously analyzed asset categories, the research includes ETFs, aligning with studies conducted in other regions. In practical terms, it contributes to the formulation of investment strategies for efficient international portfolios, especially for individual investors, given that transaction costs and other potential barriers may limit the benefits of international diversification.

2 Theoretical Framework

2.1 International Portfolio Diversification

Modern Portfolio Theory posits that when seeking to maximize expected return for a given level of risk, or minimize risk for a given expected return, portfolios should be constructed with weakly correlated assets (Narayan et al., 2023). To this end, the expected return and the variance-covariance matrix of asset returns are considered to construct an optimal portfolio (Rodríguez et al., 2021), which relates to the concept of diversification.

In this context, the topic of international portfolio

diversification has attracted attention in the literature due to the growing integration between financial markets and, which complicates the optimization of investment portfolios (Migliavacca et al., 2023). This is because, although it is common to use assets with low correlation to mitigate short-term risks, the absence of joint movements in the long term cannot be guaranteed (Narayan et al., 2023), which may reduce the benefits of international diversification (Thomas et al., 2017).

However, although greater correlation among markets generally reduces the benefits of international diversification, research by Mensi et al. (2017) and Guidi et al. (2025) indicates that these benefits vary in times of crisis. These findings support the idea that international diversification is affected by market conditions (O'Hagan-Luff & Berrill, 2019; Bányai et al., 2025).

2.2 Domestic Assets Exposed to Foreign Markets

Among the options for domestic assets with exposure to foreign markets, ETFs stand out for being similar to open-end funds, but with the advantage of trading at market price throughout the trading session (Miralles-Quirós et al., 2019). Furthermore, they are characterized by their low cost and capacity for efficient diversification (Li & Jiang, 2025).

As empirical evidence of the benefits of diversification through ETFs, Bányai et al. (2025), when comparing a geographically diversified portfolio with one focused on European markets, concluded that geographic diversification can enhance the risk-adjusted return of portfolios during periods of economic growth. Furthermore, from the perspective of U.S. investors, Tsai and Swanson (2009) demonstrated that ETFs exhibit superior risk-adjusted average performance compared to single-country active funds not linked to indices, while Miralles-Marcelo et al. (2015) showed that dollar-denominated ETFs have a higher Sharpe ratio than direct investment in the benchmark market in their local currency.

There is also evidence that multivariate weight optimization models can outperform the equally weighted portfolio approach (Miralles-Marcelo et al., 2015; Miralles-Quirós et al., 2019). It should also be noted that ETFs can be used as hedging mechanisms during times of crisis (Han, 2025).

Thus, considering that, as passive funds, ETFs tend to allow for international diversification at lower costs (Li & Jiang, 2025) and that, there is evidence of diversification benefits with this asset class in other markets (Tsai & Swanson, 2009; Miralles-Marcelo et al., 2015; Miralles-Quirós et al., 2019; Bányai et al., 2025; Han, 2025), the following research hypothesis is formulated:

H1 - Diversification through international equity ETFs improves the risk-adjusted returns of Brazilian investors' portfolios.

Another option for exposure to foreign equity markets available to Brazilian investors is BDRs, which consist of asset-backed securities issued abroad (usually stocks). For this asset class, there is evidence of a net return slightly higher than that of direct investment in the underlying assets (Souza et al., 2025). Furthermore, portfolios composed mainly of BDRs exhibit lower correlation with the Brazilian market and a higher Sharpe ratio, while portfolios composed mainly of investment funds with international exposure exhibit lower volatility (Borges & Malaquias, 2017).

From the perspective of U.S. investors, O'Hagan-Luff and Berrill (2019) considered domestic assets with exposure to foreign markets to include ETFs, multinational companies (MNCs), and American Depositary Receipts (ADRs), which are, in essence, similar to BDRs but applied to that market. Among the results, it was found that most portfolios with ETFs presented lower risk compared to portfolios with ADRs.

Thus, considering that the benefits of international diversification vary across classes of domestic assets with exposure to foreign markets in Brazil (BDRs and investment funds) and in the United States (ETFs and other asset classes) (Borges & Malaquias, 2017; O'Hagan-Luff & Berrill, 2019), the following research hypothesis is formulated:

H2 - Diversification through international equity ETFs offers a better risk-adjusted return than that achieved with BDRs, from the perspective of Brazilian investors.

A third option for domestic assets with international exposure is investment funds. In this regard, challenging the prevailing view that global economic crises invariably have negative effects on emerging markets, Vasconcelos and Teixeira (2024) demonstrated that such events can positively influence the performance of Brazilian investment funds.

However, it is known that some investment funds exhibit a performance fee. In this context, Grossi and Malaquias (2019), in their analysis of the international diversification of Brazilian mutual funds across assets in developed and emerging markets, noted that this variable negatively explains the volatility of returns. Furthermore, when evaluating only funds with positive performance, it was found that the performance fee positively explained the Sharpe ratio.

So, considering that Brazilian mutual funds are

characterized by a low level of international diversification (Grossi & Malaquias, 2019) and that ETFs, being passive funds, do not have a performance fee, in addition to having no front-end loads and offering tax advantages, the third research hypothesis is presented:

H3 - International equity ETFs offer a better risk-adjusted return ratio than FIAs with foreign allocations, from the perspective of Brazilian investors.

Furthermore, Atting et al. (2023) highlight three types of risks that can be mitigated through international diversification: political, inflationary, and market risks. In this context, considering market indices, the literature indicates that emerging economies have limited opportunities for diversification among themselves due to integration, as evidenced by Patel (2022), Mensi et al. (2023), and Medetoğlu (2025). From the perspective of Brazilian investors, Grossi and Malaquias (2019) concluded that funds holding stocks from developed countries tend to perform better and carry lower risk compared to those investing in emerging markets.

These results can be attributed to investor protection and more robust corporate governance (Giofré, 2014), as well as high exchange rate volatility and country risk in emerging economies (Gumus & Taşpınar, 2015; Lee et al., 2023). Furthermore, developed markets are generally less volatile, more liquid, and more information-efficient (Jiang et al., 2013).

Therefore, considering that the performance of ETFs is subject to the same factors, the fourth research hypothesis is formulated as follows:

H4 - Diversification through international equity ETFs in the stock segment backed by developed markets offers a better risk-adjusted return ratio than that of international equities in the stock segment backed by emerging markets.

3 Research Methodology

3.1 Sample Selection and Data Processing

To compose the sample, we considered the series of daily prices and logarithmic returns of (i) the Ibovespa, used as a proxy for the Brazilian market (Bickley et al., 2021; Borges & Malaquias, 2017); (ii) ETFs listed on B3; (iii) BDRs; and (iv) Brazilian FIAs with at least 25% of their assets allocated abroad.

The observations covered data from January 4, 2021, to June 12, 2023, totaling 607 trading days. The start date is justified by the fact that, as of the end of November 2020, there were only two ETFs with exposure to foreign stock markets listed on the Brazilian stock exchange. The end date, in turn, corresponds to the latest period available at the time of data collection.

To construct the ETF sample, we started with 264 assets. After excluding those unavailable in 2021 and those not tracking foreign stock indices, the final sample consisted of 39 ETFs. Regarding BDRs, the initial sample was 794. After excluding those unavailable at the beginning of 2021, the final sample consisted of 628 assets. For FIAs, the initial sample was reduced from 2,647 to 310 assets after excluding those unavailable in 2021 and those with less than 25% international exposure. This second filter applied to FIAs, also used by Borges and Malaquias (2017), aimed to exclude from the analysis assets that were excessively exposed to the Brazilian stock market. As a result, the final sample totaled 977 assets.

3.2 Analysis Models

Similar to Guidi and Ugur (2014), Johansen (1988) and Johansen and Joselius (1990) cointegration tests were applied to examine the long-term relationship between the analyzed time series, followed by the construction of theoretical portfolios aimed at assessing the performance of portfolios with and without cointegration. The difference is that they evaluated relationships between market indices in Southeast Europe and those in Germany, the United Kingdom, and the United States. Here, we analyze cointegration relationships and construct theoretical portfolios for based on Ibovespa series using ETFs, BDRs, and FIAs with foreign allocations.

Regarding portfolio performance, some international studies, such as Guidi and Ugur (2014), Mensi et al. (2017), and Miralles-Quirós et al. (2019), assumed the risk-free rate to be zero. Others, such as Tsai and Swanson (2009), Miralles-Marcelo et al. (2015), and O'Hagan-Luff and Berrill (2015, 2019), used U.S. Treasury bond rates.

In Brazil, it is common to use the Selic rate, as did Borges and Malaquias (2017), Grossi and Malaquias (2019), and Civiletti et al. (2020), given that it yields on government securities known as Floating Rate Treasury Notes, whereas long-term government securities, due to their longer duration and default risks, are not commonly used as risk-free in Brazil (Barros et al., 2024). This study evaluated portfolio performance under two scenarios: without a risk-free rate and using the Selic rate.

3.2.1 Cointegration Tests

Cointegration analysis is an econometric tool used to identify the long-term equilibrium between assets (Yan &

Wong, 2022). Cointegration among financial asset series suggests that, in the long run, their returns will be highly correlated, causing the reduction in long-term portfolio risk through international diversification to have a smaller impact (Taylor & Tonks, 1989). Thus, to assess the long-term relationship between Brazilian stocks (Ibovespa) and domestic asset classes with exposure to foreign stock markets (ETFs, BDRs, and FIAs with overseas allocations), we used Augmented Dickey-Fuller (ADF) tests to verify the stationarity of the series, followed by an analysis of the number of lags according to Schwarz's Bayesian Criterion (SBC), and then applied the cointegration tests of Johansen (1988) and Johansen and Joselius (1990).

It is therefore expected that the natural logarithm series of daily prices for these assets will not exhibit a stable long-term relationship (cointegration) with Brazilian stocks (Ibovespa). This is because the existence of such a long-term relationship may reduce the benefits of international portfolio diversification (Thomas et al., 2017).

3.2.2 Portfolio Diversification Strategies

After verifying the existence of a long-term relationship among the asset classes studied, theoretical portfolios were constructed using two diversification strategies. First, for each domestic asset with exposure to foreign markets in the sample, equally weighted portfolios were constructed, consisting of 50% Ibovespa and 50% of the respective domestic asset with exposure to foreign markets. Subsequently, minimum-variance portfolios were constructed, composed of the respective asset and the Ibovespa, with weights adjusted to minimize return volatility. Short selling was not considered in either strategy.

As a risk-adjusted performance measure, the ex-post Sharpe Ratio (SR) was adopted. It is known, however, that the traditional SR is subject to controversial results in cases of negative returns or risk premiums (Israelsen, 2005). This is because, in a hypothetical scenario where two or more portfolios exhibit the same negative return or risk premium, a rational investor should select, all else being equal, the one with the lowest risk, as advocated by Markowitz (1952).

In this context, since the traditional IS uses standard deviation as a measure of risk, portfolios with higher standard deviation would result in higher IS values. Such results could lead investors who use the traditional IS as a performance measure to make erroneous decisions.

Therefore, to avoid the limitations inherent in portfolios with negative returns or risk premiums, the methodology proposed by Israelsen (2005) was applied, as shown in Equation (1):

$$ISI_i = \frac{\overline{ER_i}}{\sigma_i\left(\frac{\overline{ER_i}}{abs\overline{ER_i}}\right)} \quad (1)$$

Where ISI_i is the Sharpe-Israelsen Index of portfolio i; $\overline{ER_i}$ is the excess return (risk premium) of portfolio i (in analyses without a risk-free rate, only the return of portfolio i was considered);abs $\overline{ER_i}$ is the absolute value of the excess return.

To calculate returns, in situations where the asset did not have a daily closing price, it was assumed that there was no change, and the last trading price was replicated, following the approach taken by Civiletti et al. (2020). Furthermore, it should be noted that the calculated ISIs were annualized to facilitate their understanding and that, to handle potential outliers, the performance measures were winsorized at 1%.

Once the results were available, Student's t-tests were conducted to compare means, with the null hypothesis being that the means are not different. These tests were applied to verify whether: (i) the average performance of the generated portfolios differed from the average performance of the Ibovespa; (ii) the average performance of portfolios containing assets that co-integrate with the Ibovespa differed from that of portfolios containing assets that do not co-integrate; (iii) the average performance of portfolios containing ETFs differed from the average performance of portfolios containing BDRs and portfolios containing FIAs with foreign allocations; and (iv) to compare the average performance of portfolios containing ETFs tracking indices of developed and emerging economies. The classification of ETFs into developed and emerging market indices was based on the criteria adopted by Morgan Stanley Capital International (MSCI), the same criteria adopted by O'Hagan-Luff and Berrill (2019).

4 Data Analysis

4.1 Analysis of Cointegration Statistics

Before analyzing the long-term relationship between the natural logarithm series of Ibovespa prices and domestic assets with exposure to foreign markets, the order of integration of the series was verified, due to the need for them to be stationary for the application of cointegration tests. To this end, the DFA test was applied, in which the null hypothesis of non-stationarity is tested against the alternative hypothesis that the series are stationary. As shown in Table 1, the natural logarithm series of

Ibovespa prices only became stationary when the first difference was calculated, and is therefore of order 1, I(1).

Table 1. DFA Test of the Ibovespa Price Log Series

Order of integration	Z-statistic (t)	p-value	Critical value		
			1%	5%	10%
I(0)	-2.466	0.1239	-3.430	-2.860	-2.570
I(1)	-25.253	0.0000			

Source: Prepared by the authors.
Note. I(0): represents the level series; I(1): represents the series when the first difference is calculated.

Table 2 presents a summary of the number of assets by order of integration for domestic asset classes with exposure to domestic and foreign markets, based on the results of the DFA test.

Table 2. Number of Assets by Order of Integration

H0	Interpretation	ETF		BDR		FIA		Total	
		N	%	N	%	N	%	N	%
I(0)	Stationary series at level	6	15.4	81	12.9	7	2.3	94	9.6
I(1)	Stationary series after calculating the first difference	33	84.6	547	87.1	303	97.7	883	90.4
	Total	39	100	628	100	310	100	977	100

Source: Prepared by the authors.
Note. I(0): represents the level series; I(1): represents the series when the first difference is calculated. The statistics were calculated with 95% confidence.

It is observed that less than 10% of the assets in the sample had natural logarithm price series that were level-stationary. Therefore, since they have a different order of integration from the Ibovespa, it can be concluded that the series did not exhibit a cointegration relationship with the main stock index of the Brazilian market. For the remaining assets (883), the number of lags was determined according to the CBS. Subsequently, the analysis of cointegration relationships was conducted using the Trace (λtrace) and Maximum Eigenvalue (λmax) statistics, applied to the I(1) series. The first tests the null hypothesis that there are no more than r0cointegration relationships (H0: $r \leq r0$) against the alternative hypothesis that there are more than r0cointegration relationships (Ha: $r > r0$). The second test, however, examines the null hypothesis that there are r cointegration relationships (H0: $r = r0$) against the alternative hypothesis that there are $r + 1$ cointegration relationships (Ha: $r = r0+ 1$).

Table 3 presents, in consolidated form, the number of assets and the proportion relative to the sample that exhibited a cointegration relationship with the main stock index of the Brazilian stock exchange.

Table 3. Results of the Cointegration Tests

Class	Trace Statistic (λtrace)				Maximum Eigenvalue Statistic (λmax)			
	r = 0		r ≤ 1		r = 0		r = 1	
	N	%	N	%	N	%	N	%
ETF	32	82.1	1	2.6	32	82.1	1	2.6
BDR	466	74.2	81	12.9	525	83.6	22	3.5
FIA	292	94.2	11	3.5	300	96.8	3	1.0
Total	790	80.9	93	9.5	857	87.7	26	2.7

Source: Prepared by the authors.
Note. The statistics were calculated with a 95% confidence level.

According to the Trace statistic, approximately 10% of the assets in the sample exhibited a cointegration vector with the Ibovespa. By contrast, according to the Maximum Auto value statistic, the figure is less than 3%. Proportionally, in both statistical s, the BDR class had the highest number of assets with a stable long-term relationship with the benchmark, followed by FIAs and ETFs, respectively. It should be noted that only one ETF was cointegrated with the Ibovespa during the analysis period: the iShares S&P Latin America 40 Index, which seeks to replicate the S&P Latin American 40 Index and therefore has significant exposure (approximately 60%) to Brazilian companies.

Overall, it is observed that the proportion of domestic assets with exposure to foreign markets that cointegrate with the Ibovespa is relatively low, indicating the possibility of reducing long-term risk through international portfolio diversification (Taylor & Tonks, 1989; Thomas et al., 2017). The results align with those of Guidi et al. (2025), who, upon evaluating national and sectoral stock market indices of Latin American countries (including Brazil), found that they are not fully integrated, indicating potential for international diversification. Similarly, Medetoğlu (2025) detected low levels of correlation between stock market indices in Brazil, Indonesia, India, Turkey, and South Africa.

4.2 Analysis of Portfolio Diversification Strategies

Table 4 presents the results of risk-adjusted return measures for theoretical portfolios composed of domestic asset classes with exposure to foreign markets.

Table 4. Performance of Diversified Portfolios

	Scenario without a risk-free rate		Scenario with risk-free rate	
	ISI	Premium on Ibov	ISI	Premium on Ibovespa
Benchmark: Ibovespa	-0.000004		-0.000078	
Panel A: Average performance of equally weighted portfolios				
Ibovespa ETF	0.052455	0.052460***	-0.000068	0.000010*
BDR-Ibovespa	0.158226	0.158230***	0.019655	0.019733***
FIA-Ibovespa	0.071459	0.071463***	0.000890	0.000967
Panel B: Average performance of minimum variance portfolios				
Ibovespa ETF	0.044532	0.044537***	-0.000063	0.000015***
BDR-Ibovespa	0.103800	0.103804***	0.001738	0.001816***
FIA-Ibovespa	0.129496	0.129501***	0.026355	0.026433***

Source: Prepared by the authors.
Note. ETF-Ibovespa: portfolios formed by combining the Ibovespa and ETFs; BDR-Ibovespa: portfolios formed by combining the Ibovespa and BDRs; FIA-Ibovespa: portfolios formed by combining the Ibovespa and FIAs; ISI: simple arithmetic mean of the Sharpe-Israelsen index of the portfolios formed according to the diversification strategies described in the methodology; Premium over Ibovespa: difference between the average performance of the portfolios and that of the Ibovespa. The Selic rate was adopted as the risk-free rate. Student's t-tests were applied to verify whether the average of the annualized ISIs in each diversification strategy is statistically different from that of the Ibovespa. *** and * indicate, respectively, statistical significance at the 1% and 10% levels.

During the period analyzed, the risk-adjusted performance of the Ibovespa was negative but close to zero in both scenarios (with and without a risk-free rate). In all scenarios and diversification strategies, the portfolios had an average performance superior to that of the Ibovespa. Only the average performance of the equally weighted portfolios with FIAs and BDRs in the scenario with a risk-free rate did not show a statistically significant difference.

In the equally weighted strategy scenario (Panel A), portfolios with BDRs performed best, followed by portfolios with FIAs and ETFs. In the risk-free rate scenario, although portfolios with ETFs outperformed the Ibovespa, their average performance was still negative and close to zero. Similarly, portfolios with FIAs had an average performance superior to that of the Ibovespa, but the difference was not statistically significant. In the minimum variance portfolio strategy (Panel B), portfolios with FIAs had the best average performance, followed by those with BDRs and ETFs, respectively. Furthermore, portfolios with FIAs showed better average performance in the minimum variance strategy compared to the equally weighted portfolio strategy, unlike portfolios with ETFs and BDRs.

However, although the performance of portfolios with domestic assets exposed to foreign markets outperformed the Ibovespa, confirming the benefits of international diversification, it is essential to assess cointegration with the benchmark to verify whether this long-term relationship diminishes these benefits.

In this regard, Table 5 presents the results of the cointegration tests using the Trace statistic.

Table 5. Comparison of Diversified Portfolio Performance Considering Cointegration Relationships Using the Trace Statistic

	Scenario without a risk-free rate			Scenario with a risk-free rate		
	Cointegration relationship			Cointegration relationship		
	No	Yes	Difference	No	Yes	Difference
Panel A: Average ISI of equally weighted portfolios						
Ibovespa ETF	0.05384	-0.00002	0.05386***	-0.00007	-0.00008	0.00001**
BDR-Ibovespa	0.13768	0.29698	-0.15930***	0.01698	0.03769	-0.02070*
FIA-Ibovespa	0.07290	0.03230	0.04060	0.00093	-0.00071	0.00164
Panel B: Average ISI of minimum variance portfolios						
Ibovespa ETF	0.04570	-0.00002	0.04573***	-0.00006	-0.00008	0.00002***
BDR-Ibovespa	0.09048	0.19375	-0.10327***	0.00180	0.00132	0.00048
FIA-Ibovespa	0.13167	0.07036	0.06131	0.02733	-0.00007	0.02739***

Source: Prepared by the authors.

Note. ETF-Ibovespa: portfolios formed by combining the Ibovespa and ETFs; BDR-Ibovespa: portfolios formed by combining the Ibovespa and BDRs; FIA-Ibovespa: portfolios formed by combining the Ibovespa and FIAs; ISI: simple arithmetic mean of the Sharpe-Israelsen index of the portfolios formed according to the diversification strategies described in the methodology; Difference: refers to the difference between the average ISI of portfolios containing assets that do not cointegrate with that of portfolios that cointegrate with the Ibovespa. The Selic rate was adopted as the risk-free rate. Tests were conducted to verify the homogeneity of variances, followed by Student's t-tests for two samples, in order to determine whether there is a statistically significant difference in the average performance of portfolios containing assets that are cointegrated with and those that are not cointegrated with the Ibovespa. Since there was only one ETF that cointegrated with the Ibovespa, Student's t-tests for a single sample were applied to verify whether the average performance of portfolios containing ETFs that do not cointegrate with the Ibovespa differs from the performance of portfolios containing the ETF that exhibited a cointegration relationship. ***, **, and * indicate, respectively, statistical significance at the 1%, 5%, and 10% levels.

When comparing portfolios with and without cointegration with the Ibovespa using the Trace statistic, it was observed that, in equally weighted portfolios, the average performance of portfolios without cointegration, containing ETFs or FIAs, exceeded that of portfolios with cointegrated assets. However, only one ETF showed cointegration with the Ibovespa. The difference in average performance of portfolios with FIAs was not statistically significant.

Contrary to expectations, portfolios containing cointegrated BDRs outperformed those containing non-cointegrated BDRs. A similar pattern was observed in the minimum-variance portfolios, although statistical significance was only observed in the scenario without a risk-free rate. In the scenario with a risk-free rate, significance was only observed in portfolios with ETFs or FIAs, where non-cointegrated assets outperformed the cointegrated ones.

The results of the Maximum Autovalue cointegration test are presented in Table 6.

Table 6. Comparison of Diversified Portfolio Performance Considering Cointegration Relationships Using the Maximum Eigenvalue Statistic

	Scenario without a risk-free rate			Scenario with risk-free rate		
	Cointegration ratio			Cointegration relationship		
	No	Yes	Difference	No	Yes	Difference
Panel A: Average ISI of equally weighted portfolios						
Ibovespa ETF	0.05384	-0.00002	0.05386***	-0.00007	-0.00008	0.00001**
BDR-Ibovespa	0.15516	0.24276	-0.08761*	0.02012	0.00695	0.01316**
FIA-Ibovespa	0.07100	0.11847	-0.04747	0.00090	-0.00005	0.00095
Panel B: Average ISI of minimum variance portfolios						
Ibovespa ETF	0.04570	-0.00002	0.04573***	-0.00006	-0.00008	0.00002***
BDR-Ibovespa	0.10036	0.19866	-0.09831***	0.00172	0.00224	-0.00052
FIA-Ibovespa	0.12825	0.25722	-0.12897	0.02661	-0.00003	0.02665***

Source: Prepared by the authors.

Note. ETF-Ibovespa: portfolios composed of a combination of the Ibovespa and ETFs; BDR-Ibovespa: portfolios composed of a combination of the Ibovespa and BDRs; FIA-Ibovespa: portfolios composed of a combination of the Ibovespa and FIAs; ISI: simple arithmetic mean of the Sharpe-Israelsen index of the portfolios formed according to the diversification strategies described in the methodology; Difference: refers to the difference between the average ISI of portfolios containing assets that do not cointegrate with that of portfolios that cointegrate with the Ibovespa. The Selic rate was adopted as the risk-free rate. Tests were conducted to verify the homogeneity of variances, followed by Student's t-tests for two samples, in order to determine whether there is a statistically significant difference in the average performance of portfolios containing assets that are cointegrated with and those that are not cointegrated with the Ibovespa. Since there was only one ETF that co-integrated with the Ibovespa, Student's t-tests for a single sample were applied to verify whether the average performance of portfolios containing ETFs that do not co-integrate with the Ibovespa differs from the performance of portfolios containing the ETF that exhibited a co-integration relationship. ***, **, and * indicate, respectively, statistical significance at the 1%, 5%, and 10% levels.

Considering cointegration using the Maximum Autovalue statistic, the average performance of equally weighted portfolios that did not exhibit a long-term relationship with the Ibovespa was higher for portfolios with ETFs (in both scenarios), for BDRs (in the risk-free rate scenario), and for FIAs (also in the risk-free rate scenario), although the latter did not reach statistical significance. For minimum-variance portfolios, the average performance of portfolios that do not cointegrate with the Ibovespa was higher in those composed of ETFs (in both scenarios) and FIAs (risk-free rate scenario).

It should be noted that, even in some situations where the average performance of portfolios containing assets that co-integrate with the Ibovespa was higher than those that do not co-integrate, in the long term this may hinder portfolio optimization (Migliavacca et al., 2023) and reduce the benefits of international diversification (Thomas et al., 2017). However, in general, the results suggest that it is possible for Brazilian investors to obtain diversification benefits, in terms of risk-adjusted returns, through ETFs, BDRs, and FIAs with international exposure. Naturally, the magnitude of the improvement in risk-adjusted returns varies, among other factors, according to the asset class used, and this is consistent with the findings of O'Hagan-Luff and Berril (2019).

Therefore, H1 cannot be rejected, since, during the period analyzed, diversified portfolios with ETFs presented, on average, a better risk-adjusted return than the Ibovespa, with only one asset showing a long-term relationship with the Brazilian stock market. However, in the scenario using the Selic rate as the risk-free rate, the average performance of the portfolios with ETFs and the Ibovespa was close to zero.

The findings also indicate that, on average, portfolios with ETFs underperformed those with BDRs and FIAs. However, it is necessary to verify whether this difference is statistically significant. To this end, a student's t-test was conducted comparing the risk-adjusted returns of portfolios with ETFs, BDRs, and FIAs. The results are presented in Table 7.

Table 7. Comparison of the Average Performance of Domestic Asset Classes with Exposure to Foreign Markets

	Scenario without a risk-free rate		Scenario with risk-free rate	
	Average	Difference	Average	Difference
Benchmark: Ibovespa ETF	0.05246	-	-0.00007	-
Panel A: Average ISI of equally weighted portfolios				
BDR-Ibovespa	0.15823	0.10577***	0.01966	0.01972***
FIA-Ibovespa	0.07146	0.01900**	0.00089	0.00096
Benchmark: ETF-Ibovespa	0.04449	-	-0.00006	-
Panel B: Average ISI of minimum variance portfolios				
BDR-Ibovespa	0.10380	0.05931***	0.00174	0.00180***
FIA-Ibovespa	0.12950	0.08500***	0.02636	0.02642***

Source: Prepared by the authors.
Note. ETF-Ibovespa: portfolios formed by combining the Ibovespa and ETFs; BDR-Ibovespa: portfolios formed by combining the Ibovespa and BDRs; FIA-Ibovespa: portfolios formed by combining the Ibovespa and FIAs; Average: represents the average ISI performance of the portfolios; Difference: represents the difference between the average ISI of the portfolios and the average ISI of portfolios containing ETFs. The Selic rate was used as the risk-free rate. Student's t-tests were applied to a sample to verify whether the average performance of portfolios containing BDRs or FIAs differs from the average performance of portfolios containing ETFs. *** and ** indicate, respectively, statistical significance at the 1% and 5% levels.

The results show that the average performance of portfolios containing BDRs was superior to that of portfolios containing ETFs in both diversification strategies (equally weighted and minimum variance portfolios) and scenarios (with and without a risk-free rate), with statistical significance. Therefore, H2 is rejected, since, in general, the risk-adjusted return of portfolios with ETFs was lower than that of portfolios with BDRs.

The results are consistent with those of Borges and Malaquias (2017), who identified superior performance in portfolios with BDRs compared to those including mutual funds. Furthermore, they corroborate the study by O'Hagan-Luff and Berrill (2019) on the U.S. market, which found that, in weight-optimized portfolios, ETFs provide diversification benefits in terms of risk-adjusted return, although they still lag behind portfolios with other asset classes, such as ADRs and MNCs.

The results show that, in minimum-variance portfolios, portfolios with FIAs had a higher average return than those with ETFs in both scenarios (with and without a risk-free rate). In equally weighted portfolios, portfolios with FIAs also outperformed those with ETFs in the scenario without a

risk-free rate. In the scenario with a risk-free rate, although equally weighted portfolios with FIAs outperformed those with ETFs, this difference was not statistically significant.

Since, in no scenario or strategy, domestic and international equity ETFs outperformed FIAs with overseas allocations in terms of risk-adjusted returns, H3 is rejected. One possible explanation for the superior performance of portfolios containing FIAs is that they may benefit from more active management. Evidence suggests that the management fee is positively related to performance (Grossi & Malaquias, 2019).

Next, we tested the differences between the average performance of portfolios with ETFs exposed to developed, emerging, and global markets (with exposure to both). The results are presented in Table 8.

Table 8. Comparison of the Average Performance of Portfolios with Developed, Emerging, and Global Market ETFs

			Difference between markets		
Markets	N	ISI	Developed	Emerging	Global
Panel A: Equally weighted portfolios (scenario without risk-free rate)					
Developed	24	0.055384	0.000000	-0.007032	-0.008782
Emerging	10	0.048352	0.007032	0.000000	-0.001750
Overall	5	0.046602	0.008782	0.001750	0.000000
Panel B: Minimum variance portfolios (scenario without a risk-free rate)					
Developed	24	0.046027	0.000000	0.002494	-0.016647
Emerging	10	0.048521	-0.002494	0.000000	-0.019142
Overall	5	0.029380	0.016647	0.019142	0.000000
Panel C: Equally weighted portfolios (risk-free rate scenario)					
Developed	24	-0.000055	0.000000	-0.000044**	-0.000011
Emerging	10	-0.000099	0.000044**	0.000000	0.000033
Overall	5	-0.000066	0.000011	-0.000033	0.000000
Panel D: Minimum variance portfolios (risk-free rate scenario)					
Developed	24	-0.000055	0.000000	-0.000028**	-0.000008
Emerging	10	-0.000083	0.000028**	0.000000	0.000021
Overall	5	-0.000062	0.000008	-0.000021	0.000000

Source: Prepared by the authors.
Note. Developed: portfolios formed by combining the Ibovespa and ETFs from developed countries; Emerging: portfolios formed by combining the Ibovespa and ETFs from emerging countries; Global: portfolios formed by combining the Ibovespa and ETFs with exposure to both developed and emerging countries simultaneously; ISI: average portfolio performance measured by the Sharpe-Israelsen index; Market difference: the difference between the ISI of the portfolios in the columns and that of the rows. The Selic rate was used as the risk-free rate. Tests were conducted to verify the homogeneity of variances, followed by Student's t-tests for two samples, to determine whether the difference in average performance between portfolios with exposure to developed, emerging, and global markets is significant. ** indicates statistical significance at the 5% level.

In the scenario without a risk-free rate (Panels A and B), there was no statistical significance, regardless of the weighting strategy. However, in the scenario with a risk-free rate (Panels C and D), portfolios with ETFs exposed to developed markets outperformed those exposed to emerging markets in both strategies (equally weighted and minimum variance portfolios). Although the average performance of ETFs exposed to developed markets also exceeded that of global ETFs, the difference was not significant.

Therefore, H4 cannot be rejected, since the average performance of portfolios with developed-market ETFs was superior to that of emerging-market ETFs, regardless of the diversification strategy. These results are consistent with those of Grossi and Malaquias (2019) for the Brazilian mutual fund industry. Furthermore, the findings confirm the idea that ETFs with exposure to different geographies can be used as hedging instruments (Han, 2025), while helping to reduce risks (Li & Jiang, 2025), particularly those related to market, political, and inflation issues (Attig et al., 2023).

Table 9 presents a summary of the conclusions regarding the hypotheses.

Table 9. Conclusion on the Research Hypotheses

Hypothesis	Description	Result	Decision
H1	Diversification through international equity ETFs improves the risk-adjusted returns of Brazilian investors' portfolios.	Portfolios diversified with ETFs outperformed the Ibovespa on average, with only one asset showing a cointegration relationship.	Do not reject
H2	Diversification through international equity ETFs offers better risk-adjusted returns than diversification through BDRs, from the perspective of Brazilian investors.	Overall, the average performance of portfolios with ETFs was lower than that of portfolios with BDRs.	Reject
H3	International equity ETFs offer a better risk-adjusted return ratio than mutual funds with foreign allocations, from the perspective of Brazilian investors.	In no scenario or strategy did the average performance of portfolios with ETFs exceed that of portfolios with FIAs.	Reject
H4	Diversification through international equity ETFs backed by developed markets offers a better risk-adjusted return ratio than that of international equity ETFs backed by emerging markets.	The average performance of portfolios with developed-market ETFs was superior to that of emerging-market ETFs, regardless of the diversification strategy.	Do not reject

Source: Prepared by the authors.

5 Final Considerations

This study, conducted following the issuance of SEC Instruction No. 03/2020, which facilitated access to domestic assets with foreign exposure, aimed to comparatively analyze the potential benefits of international diversification, in terms of risk-adjusted returns, through ETFs, BDRs, and FIAs with foreign allocations from the perspective of Brazilian investors. To this end, daily data on the prices and returns of the Ibovespa, as well as ETFs, BDRs, and FIAs, were analyzed from January 4, 2021, to June 12, 2023, totaling 977 assets and 607 trading days.

Using a methodology similar to that of Guidi and Ugur (2014), we first examined the long-term relationships (cointegration) between the Ibovespa and domestic assets with exposure to foreign markets. A low proportion of assets cointegrated with the Ibovespa was observed, with BDRs being the asset class with the highest proportion of cointegration. Next, theoretical portfolios were constructed by combining the risk-adjusted return of the Ibovespa with that of a domestic asset exposed to foreign markets, using two diversification strategies (equal weighting and minimum variance) and two scenarios (without a risk-free rate and with the Selic rate). The average performance of the portfolios exceeded that of the Ibovespa, indicating the benefits of international diversification with domestic assets.

The results showed that portfolios with ETFs or FIAs not cointegrated with the Ibovespa performed, on average, better than those with cointegrated assets. Although BDRs were the asset class with the strongest cointegration relationships with the Ibovespa, some portfolios with cointegrated BDRs outperformed those with non-cointegrated BDRs in terms of average performance. The results were sensitive to the cointegration statistic, the scenario (with and without a risk-free rate), and the diversification strategy (equal weighting and minimum variance).

Thus, investors who take a more passive approach to managing their portfolios can improve their performance by adding ETFs and FIAs to their portfolios, since a single asset in these categories typically constitutes, in and of itself, a diversified portfolio with effective diversification capabilities (Li & Jiang, 2025; Vasconcelos & Teixeira, 2024). For those who prefer to individually select the assets that make up their portfolio, BDRs have proven to be an interesting option, given that, on average, the performance of portfolios containing this asset class was superior, although it also had the highest proportion of assets cointegrated with the Ibovespa, thus requiring careful analysis.

Furthermore, since previous studies on international diversification for Brazilian investors focused on BDRs (Borges & Malaquias, 2017) and investment funds (Borges & Malaquias, 2017; Grossi & Malaquias, 2019), and that international studies have also included ETFs (Errunza et al., 1999; Tsai & Swanson, 2009; Miralles-Marcelo et al., 2015; Miralles-Quirós et al., 2019; O'Hagan-Luff & Berrill, 2015, 2019; Bányai et al., 2025; Li & Jiang, 2025; Han, 2025), a comparison was also made of the average performance of portfolios with ETFs from developed, emerging, and global markets. In the scenario without a risk-free rate, the average performance of portfolios with ETFs from developed, emerging, and global markets was similar. However, when the Selic rate was considered as the risk-free rate, portfolios with ETFs from developed markets presented, on average, a better risk-adjusted return than those with ETFs from emerging markets, both for equally weighted portfolios and for the minimum variance strategy.

This study advances the literature on international portfolio diversification by assessing the stability of the benefits of investing in domestic assets with exposure to foreign markets and by including ETFs as a new asset class. Furthermore, it provides empirical evidence for the creation of investment strategies aimed at an efficient international portfolio, especially

for individual investors, who are subject to transaction costs and barriers when investing directly abroad.

The main limitation of this study is the short analysis period, as most ETFs with exposure to foreign markets for Brazilian investors have only recently begun trading. Furthermore, the low liquidity of some assets in the sample may have impacted the results. Finally, the study focused only on assets backed by foreign market equities, not addressing the international diversification of domestic assets in other categories, such as fixed income, commodities, and crypto assets.

For future studies, it is recommended to expand the analysis to include other categories of domestic assets with exposure to foreign markets, such as MNCs, as studied by Errunza et al. (1999) and O'Hagan-Luff and Berrill (2015, 2019) for the U.S. market. Another approach would be to explore the benefits of international diversification through domestic assets backed by fixed income (public and private), commodities, and crypto assets.

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