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ORIGINAL ARTICLE

Dividend-yield variation as an asset selection criterion in momentum strategies of Brazilian real estate investment trusts

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ABSTRACT

We aimed at showing the usage of the dividend-yield (DY) variation as a criterion for selecting Brazilian real estate investment trusts (BR-REITs) in momentum strategies. The identification of momentum in BR-REITs with this selection criterion is, to the best of our knowledge, new and gives rise to different strategies that seize abnormal returns. This study allows a new understanding of the dynamics between prices and dividend payments, which compose BR-REITs returns. It is of major importance, considering the relevance of the DY ratio for the asset class. The studied strategies delivered results above the industry's index with expressive magnitude, are of simple elaboration, and can be applied by any individual or institutional investor. Portfolios' performances were measured by Sharpe ratio (SR), alpha of the Fama and French three-factor model, and excess returns obtained in relation to the BR-REITs' index. Statistical tests were applied to verify the significance of the results. This study showed that strategies around the momentum effect that buy (sell) BR-REITs with greater (smaller) DY variations in previous months tended to have superior performance to the industry's index.

Keywords: real estate investment trust (REIT), momentum effect, predictability, dividend-yield, stock market.

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1. INTRODUCTION

According to Brasil, Bolsa, Balcão (B3, 2021), Brazilian real estate investment trusts (BR-REITs) are classified as a segment constituted at its most by individual investors, rather than institutional ones. This is observed when both traded volume and value of the assets under custody are analyzed for each kind of investor.

This industry evolved sharply in the last decade, having grown its number of investors almost 100 times, and having improved its regulatory framework with several new legislations. One specific issue that has changed is that since 2020 it became possible to short BR-REITs at B3, the main and only stock exchange in Brazil.

Theoretical evidence indicates that dividend-yield (DY) variation may be a useful criterion for selecting assets in BR-REITs. Momentum theories are divided in the literature between prices and earnings momentum. The present paper's suggestion of using DY variation is motivated by the theoretical evidence provided by both theories and is to the best of our knowledge new in the related literature.

Chordia and Shivakumar (2006) results show that price momentum and earnings momentum are related. Considering this, using the DY variation as a criterion for selecting assets in momentum strategies allows an investor to seek, by analyzing the same variable, both price and earnings momentum. Following the relation found by Chordia and Shivakumar (2006), it is possible to consider the hypothesis that there is information on dividend growth (drop) that is not immediately and proportionally incorporated into BR-REITs' prices. This situation would conduct to higher (lower) DY compared to previous periods due to different phenomena like underreaction, overreaction, and other factors influencing the capacity of the BR-REITs' industry to efficiently price assets, originating possible winner (loser) BR-REITs in momentum strategies.

In addition, the hypothesis that there is information indicating worse (better) future performance of a BR-REIT causing excessive drops (spikes) in prices that are not justified by proportional dividend decreases (increases) would also conduct to higher DY compared to previous periods, originating possible winner (loser) BR-REITs in subsequent periods. This hypothesis is related to the findings of Zhu et al. (2020), which show that price influences on the DY variation may occur because there could be a preference among REITs' investors for seeking lottery-like payoffs in REITs. This means REITs' investors tend to look for investments that have had high volatility in previous periods. Therefore, when these high volatilities have not been justified by respective dividend payments, DY variation may act as a criterion for portfolio formation in momentum strategies.

Considering that in both cases prices would tend to adjust to the level justified by earnings (dividends), it is expected to find that greater (smaller) DY variations tend to indicate better (worse) future performance. The impact of such theoretical result is important because with the use of this one variable (DY variation) it is possible to obtain returns from both underreaction and overreaction, positioning this strategy between price and earnings momentum theories.

Therefore, the main contribution of this work is showing that for BR-REITs, the DY ratio variation showed to be a good way to segregate between next-time winners and losers in momentum strategies. This is different from the general momentum theory, which utilizes past returns or other performance measures as selection criteria.

To the best of our knowledge, the usage of the DY variation as the selection criterion for portfolio formation in BR-REITs is a completely new finding in the related literature. What motivates this is that the DY is a measure of the relative price of BR-REITs, meaning that an investor buys the yield as a proxy for the expected return of the asset, taking on risks of price and dividend variations. Therefore, the related literature, based on earnings and price momentum, provide evidence that the DY is an important measure of performance for REITs. Its variation may show irregularities in risk-return dynamics that the variable in level cannot.

Since our results show the Brazilian literature has mostly focused on seeking risk-based explanations for changes in returns of BR-REITs, the contribution of this work is specifically addressing the asset class in the light of the momentum effect. Furthermore, this is important because stocks have been prioritized in the Brazilian finance literature in general and the space occupied by BR-REITs research has been little. The evaluation of the market inefficiencies presented in this paper for BR-REITs is new in the Brazilian finance literature and may open a fruitful path.

Finally, the fact that the strategies analyzed generated substantial returns in comparison to the BR-REITs' industry portfolio is of extreme importance not only to fund managers, but also to unsophisticated investors.

The strategies analyzed are of simple elaboration and made use of variables available to any investor, making its adoption possible by almost any kind of investor, let alone institutional and professional investors.

2. LITERATURE REVIEW

2.1 Momentum Effect

An important strategy developed in the finance literature is the one based on the momentum factor, which consists of forecasting future returns in the short-term based on the recent past performance of an asset. In their seminal paper, Jegadeesh and Titman (1993) demonstrate the formation of winner and loser portfolios based on past returns. By buying winner portfolios and selling the loser ones, they find significantly positive returns that could not be explained by risk exposure. They also find evidence that portfolios formed under the past return criterion tend to have their returns dissipated and reversed after 12 months. This finding contradicts the efficient market hypothesis.

Thus, challenging the hypothesis of efficient markets developed by Fama (1970), the former authors propose that some factors to which investors are subjected can explain the existence of momentum and reversals. They hypothesize that the concepts of underreaction and overreaction can explain the existence of momentum and reversals, respectively.

Underreaction (Jegadeesh, 1990; Lo & MacKinlay, 1988; Poterba & Summers, 1988) is an emotional response from investors that prevents them from fully incorporating new information into asset prices. According to the model developed by Barberis et al. (1998), it occurs due to investor conservatism, which consists of resistance to changing beliefs in the face of new information.

Overreaction (Bondt & Thaler, 1985, 1987), in turn, generates reversals because it is an emotional response from investors that encourages sales of assets exaggeratedly. The model developed by Barberis et al. (1998) presents the representativeness heuristic, which means that investors expect the patterns in small samples to be similar to the parent population and to reflect the process that builds it, such as investor sentiment that explains the overreaction.

Other explanations for momentum and reversals are found in Hong and Stein (1999), who adopt the speed of information diffusion among investors, which they consider low, as an explanation for the occurrence of momentum. This indicates that underreaction causes momentum. Daniel et al. (1998) contradict the scheme of underreaction causing momentum and overreaction causing reversal. They show that overreaction causes momentum based on investors' overconfidence. Furthermore, overreaction can turn into continuing overreaction if future information confirms investor beliefs.

In Brazil, empirical studies on the momentum effect on the stock market predominate. Civiletti et al. (2020) find the persistence of returns when using strategies structured around the momentum effect in Brazilian stocks. They analyze 64 portfolios composed of winners and losers and find representative evidence that the Brazilian stock market is subject to the existence of the momentum effect. Carneiro and Leal (2017) analyze asset selection criteria such as past returns, Sharpe ratio (SR), DY, and liquidity to assess the past performance of Brazilian stocks. Thus, the literature shows that several criteria can be used in strategies that seek to capture trends in the momentum effect.

Mendonça et al. (2017) evaluate the use of the SR and the historical Jensen's alpha as selection criteria for equity investment funds. Leal and Campani (2016) propose the use of equally weighted portfolios to develop two stock indexes that later gave rise to the valor-COPPEAD indexes currently available for Brazilian investors. One of them, which seeks the maximum return with the same volatility as the whole Brazilian stock market, is based on the momentum effect: in this case, the Israelsen's (2005) adjusted SR is used.

2.2 REITs

In this paper, which is denoted as BR-REIT is what is known in Brazil as *fundos de investimentos imobiliários* (FII). BR-REITs can be considered the corresponding assets on the Brazilian stock exchange to the American REITs. Despite some differences in the regulation of American REITs and BR-REITs and some particularities that do not make them exactly the same, BR-REITs are very similar to American REITs.

According to B3 (2021), there is a predominance of individual investors in BR-REITs when compared to institutional ones. This indicates that this asset class

may be subject to market inefficiencies, given the lower sophistication of this kind of investor, according to the definition presented in Carneiro and Leal (2017). Furthermore, because it is an incipient industry and it is still in a maturation process, it may be exposed to such inefficiencies.

This maturation process takes place since 2008, when the Brazilian Securities Exchange Commission (Comissão de Valores Mobiliários [CVM]) created Instrução CVM n. 472 (2008), bringing greater regulatory organization. Since then, there has been a spike in the total number of investors in this class, which was of approximately 12,000 in December 2009, and in December 2020 had already reached approximately 1,172,000, according to B3 (2021). The predominance of individual investors is clear when assessing that they correspond to more than 99% of the total number of investors, based on the same publication. The tax exemption offered by Brazilian legislation for BR-REITs mostly composed of this type of investor partly explains their greater participation.

In contrast to the evidence that the BR-REITs' class is subject to market inefficiencies, the finance literature in Brazil has shown greater interest in studying the returns of BR-REITs based on explanatory variables associated with risks. Oliveira and Milani (2020) perform a risk-return analysis that shows that the Bovespa Index (Índice Bovespa [IBOVESPA]), among the various variables studied, is the one that best explains the return of the BR-REITs' index (Índice de Fundos de Investimentos Imobiliários [IFIX]). On the other hand, Dias (2019) finds that the returns of BR-REITs and those of the market (measured by the IBOVESPA) have a low covariance when evaluated by the beta of the capital asset pricing model (CAPM) model.

In addition, previous articles (Amato et al. 2005; Calado et al. 2002) studied basic characteristics of BR-REITs, such as predominant sectors of activity, number of investors, etc., during the initial maturation process of this asset class. More recently, Nascimento et al. (2020) evaluated returns of BR-REITs in the period from 2010 to 2019, considering the influences of aspects such as management, regulation, and taxation. Detaching from the general tendency of the literature to evaluate risk variables and basic characteristics of BR-REITs, Guimarães (2013) uses the four-factor model of Carhart (1997) in a small sample of real estate funds. A tendency of performance maintenance is found, observing the persistence of returns (momentum) in BR-REITs with higher profitability.

The international literature, in turn, shows that behavioral factors influence the return of REITs, generating momentum and reversal strategies. Chui et al. (2003) find momentum in REITs that cannot be explained by risk variables. Thus, they propose a behavioral explanation based on the theory of Daniel et al. (1998). They state that from 1992 onwards, there is evidence that changes in the management style of REITs and corporate structuring made the valuation of this asset class more difficult, making investors more susceptible to acting with overconfidence. In this context, the adoption of the strategy proposed by Jegadeesh and Titman (1993) for a sample of REITs, generated 0.89% of monthly return from 1983 to 1999. This return was higher than the 0.49% generated by the same strategy applied to stocks, indicating that momentum in REITs had greater magnitude in the period.

Hung and Glascock (2008) find higher returns obtained with momentum strategies from 1992 onwards. From that year onwards, there were also higher rates of DY. From this, they analyze that these higher rates partially explain the returns obtained with those strategies. Furthermore, the authors show that DY are higher (lower) among ranked winners (losers) as a function of past returns. The use of the DY in the study by Hung and Glascock (2008) is presented as a risk-based explanation for the existence of momentum, that is, they justify the existence of momentum due to the risk inherent to variations in the DY.

More recently, there has been other studies associating momentum returns in REITs. Hao et al. (2016) find empirical evidence that different winner and loser portfolios strategies deliver different momentum returns in the REITs' industry. In another empirical paper, Bron et al. (2017) studied REITs in Europe and United Kingdom and found evidence of momentum, differentiating between price and earnings momentum. Using a direct measure for continuing overreaction of Byun et al. (2016), Liu and Lu (2019) find that a continuing overreaction strategy in American REITs would earn positive and significant returns.

Further discussion on what reasons might influence BR-REITs' industry and, possibly, influence momentum in this asset class must be made. Considering BR-REITs' asset class is still evolving, abnormal returns observed in momentum strategies might be originated by the inefficiencies of such evolving industry. For instance, a major issue in this asset class is illiquidity, which may be preventing dividend information to be fully incorporated to prices. Serra and Moraes (2017) and Lang and Scholz (2015) identify liquidity issues in REITs. It is possible to hypothesize that this is the reason that partly explain the absence of institutional and foreign investors, which creates barriers to overcoming the liquidity problem. Letdin et al. (2019) show that illiquidity in REITs partially

explain returns. Another factor that may partially explain the existence of momentum is the asymmetric and difficult access to information by investors, which is translated by the few numbers of assets that are covered by specialists. Finally, other factors to be considered are the impact ex-dividend policies and dates, the impact of splits, among others.

In line with the empirical and theoretical evidence of the international literature and aiming to fill a gap in the Brazilian literature, the following section presents the methodology applied to study BR-REITs in the light of momentum strategies. After that, in section 4, results are presented, basing the conclusions in section 5. Bibliographic references are presented at the end.

3. METHODOLOGY

3.1 Data

The analysis was carried out for the period from January 2012 to December 2020, thus comprising 9 complete years. The period of analysis started 1 year after the release of the first monthly IFIX return data. Based on the asset selection criterion proposed in the present work, monthly values of the DY were extracted from the platform Economatica, considering the dividends paid during the previous 12 months, composing an annualized value for each BR-REIT, in order to avoid seasonality issues in DY payments. Regulation forces BR-REITs administration to distribute 95% of their profits (measured on a cash-flow basis) every semester, which assures that there is no space for discretionary payments. Therefore, by considering annualized DY, we assume that there is no impact of informational and managerial influence on DY series.

Annual DY, thus, are calculated each month by considering the total amount of dividends paid in the last 12 months divided by closing prices. We have performed a balanced panel analysis. Considering we have analyzed the variation of the annual DY for 12 months, we needed 24 months of DY payment information. Therefore, to elaborate this panel, we have filtered BR-REITs that paid dividends for 24 months. Thus, the rankings considered BR-REITs that traded on the B3 stock exchange and paid dividends for at least 24 months, leaving a total of 137 funds over the entire period of analysis. The total number of BR-REITs analyzed each month varied according to the launch of new funds and the closing of others.

In addition, monthly closing quotations for each BR-REIT were extracted from Economatica, values from which returns were obtained to evaluate the performance of the portfolios prepared. For this purpose, values adjusted by earnings were considered. For a few situations in which a fund has not been traded in each month due to illiquidity reasons, the return of IFIX was adopted to make up for the lack of return information. Finally, the monthly closing prices of the BR-REITs industry index (IFIX) and the Brazilian interbank deposit certificate (*certificado de depósito interbancário* [CDI]) rate were also extracted from Economatica, and they served as, respectively, the BR-REITs' return and the risk-free interest rate.

3.2 Portfolio Formation

3.2.1 Selection criterion and formation period

The criterion used to differentiate between winners and losers was the DY variation. For that, it was necessary to calculate the DY at the end of each month, considering the total dividends paid in the last 12 months divided by the closing prices of that month. From this information of DY it was possible to calculate DY variations. DY variations were used as the selection criterion of winners and losers.

Considering this, the geometric mean of these monthly DY variations was calculated for a determined period. This period is denoted as the formation period ('i'). The formation period consists of the period determined for evaluating the DY variation and in this paper will adopt the values of 1, 3, 6, 9, and 12 months. Mathematically, the calculation of this geometric mean can be simplified as the calculation of the i-th root of the ratio between the DY paid in the analyzed month 'm' (DY_m) and the DY paid 'i' months before (DY_{m-i}). Equation 1 presents the process of calculating the criterion ΔDY_m for a given month 'm':

$$\Delta DY_m = \sqrt[i]{\prod_{k=1}^{i}\left[\left(DY_{m-k+1} / DY_{m-k}\right)\right]} - 1 = \sqrt[i]{DY_m / DY_{m-i}} - 1 \quad \boxed{1}$$

An example may help: in a generic month of January of year 2, suppose a BR-REIT had paid $ 10 in total dividends from February of year 1 to January of year 2. Consider that its price in the end of February was $ 100. This generates a DY of 10%. Suppose now a formation period of 3 months ('i' = 3). Imagine that 3 months before (in October of year 1), the same BR-REIT had paid $ 5 in total dividends from November of year 0 to October of year 1, and its price was the same $ 100. This generates a DY of 5%.

In this case, a value of 2 is obtained when calculating the ratio between the DY of January of year 2 and the DY of October of year 1, i.e., an increase from 5% to 10%. Therefore, taking the 3-th root of 2, the DY variation considered in January of year 2 is of approximately 26% per month, considering the formation period of 3 months. The rankings of the subsequent month (February of year 2) can make use of this information.

The elaboration of such variable considers the dynamic behavior between dividends payments and prices. So, if dividends payment increases (decrease) and prices do not adjust proportionally to this new information, the DY tends to increase (decrease) originating a possible winner (loser). Respectively, if prices increase (decrease) due to new information and dividends payment do not change proportionally to this new information, the DY tends to decrease (increase) originating a possible loser (winner). Following a strategy that uses this variable as a criterion for choosing assets may deliver a contrarian approach for example when dividends do not change but prices drop. Also, such a strategy may follow the market's behavior when momentum is seized, for example, when dividends increase but prices do not immediately adjust to the level of fundamentals.

3.2.2 Size and weights of the portfolios

The second parameter that varied among portfolios was their size, i.e., the number of constituents. The BR-REITs were organized into quantiles in each month, following the rankings formed. The BR-REITs present in the 10%, 20%, and 30% quantiles were selected by the winner portfolios, corresponding to those that had the greatest DY variation in the formation period analyzed. The portfolios of losers, in turn, were composed of BR-REITs present in the 90%, 80%, and 70% quantiles, corresponding to those that had the smallest variation or the largest drop in the DY in the analyzed formation period. Thus, winner (loser) portfolios were composed of the winner (loser) 'j' BR-REITs, being the parameter 'j' the variable that will adopt the values of 10% (90), 20% (80), and 30% (70%). Since we have used percentages, we defined a criterion that rounded up the values that accounted decimal numbers of BR-REITs in the portfolios. From this point on, we will only refer to the 10%, 20%, and 30% quantiles, being certain that when addressing losers, these quantiles refer to the bottom of the ranks.

The constituents entered the portfolio in the same proportion in terms of value. According to Benartzi and Thaler (2001), it constitutes a good alternative to portfolio weighting for unsophisticated investors. Due to its simplicity and to keep the focus on the constituents picking strategy instead of on any other weighing strategy, 1/N portfolios were used.

3.2.3 Holding period

Momentum theories indicate that the abnormal returns seized by it come from market inefficiencies. These inefficiencies, in turn, tend to dissipate over time, from the moment they begin to be identified by the market. Therefore, the strategies developed sought to take advantage of short-term anomalies, adopting monthly rebalancing of the portfolios (holding period equals one month).

3.3 Transaction Costs and Taxes

Transaction costs of 0.0050% referring to trading costs and of 0.0250% referring to settlement costs paid to B3 were considered, totaling a percentage of 0.0300% that levied on the total financial value of each purchase or sale. In addition to these costs, income tax on portfolio liquidation was considered. According to the applicable legislation for the individual investor, taxes must be paid until the last day of the month after the month in which a strategy was liquidated. In this paper, income taxes were recorded at the end of each month considering the rate of 20% when the profit of a strategy was calculated to be positive. In turn, when the strategies delivered negative results, those were accumulated to compensate future profits.

3.4 Strategies and Performance Evaluation

What are denoted as portfolios are the 1/N sets of BR-REITs selected by DY variations. Strategies, in turn, denote any set of predefined buy and sell transactions that make use of these portfolios. For instance, a possible strategy is a long one that buys a winner portfolio.

Usually, momentum strategies involve buying winner portfolios and possibly selling loser ones. In the results section, the strategies that involve buying (selling) winners (losers) will use the letter 'W' ('L') as a reference. The results shown in the referred section will correspond to what would have been the return obtained with the long, short, long-short, and long-biased strategies if they had been adopted by an investor.

The long strategies correspond to buying winner portfolios with 100% of the capital. The short strategies correspond to selling an amount of loser portfolios corresponding to 100% of the capital, and, so, obtaining 100% of capital in leverage. To maintain 100% of the capital invested it was decided to buy 100% of CDI and

100% of IFIX. We opted to follow this structure because when performing the tests of excess return against the IFIX (i.e., subtracting the IFIX returns from the analyzed portfolio), results would correspond to the return provided by shorting the loser portfolio and the return of CDI. Therefore, as the CDI corresponds the risk-free rate, the excess return subject to risks would only be the obtained by shorting the loser portfolio.

The long-short strategies correspond to buying winner portfolios and selling loser ones by the same amount of 100% of the capital, and, so, obtaining 100% of capital in leverage. To maintain 100% of the capital invested, we opted to invest 100% at the riskless rate (CDI).

The long-biased strategies elaborated were 1.1 W-0.1 L; 1.5 W-0.5 L; and 2.0 W-1.0 L. These strategies correspond to buying winner portfolios with 100% of the capital and selling the loser ones considering different percentages of the capital (10%, 50%, and 100%, respectively), obtaining this correspondent percentage of capital in leverage. To maintain 100% of the capital invested, it was defined that the leveraged capital obtained would be invested in the same winner portfolios.

To evaluate the subsequent performance of the portfolios formed based on the selection criterion (DY variation in the prior 'i' months), the SR is used. To evaluate the strategies, two parameters were calculated, namely, excess return to the BR-REITs' index and the three-factor model's alpha, which represents a risk-adjusted return. We explain better these measures.

3.4.1 SR

The SR (Sharpe, 1966) was calculated for each portfolio according to equation 2. It is obtained by considering the difference between the arithmetic average of the monthly return on the portfolio and the arithmetic average of the monthly return corresponding to the return generated by the risk-free rate, divided by the standard deviation (SD) of the risk premium of the portfolio in relation to the risk-free rate. When returns were negative, we have adjusted SR as proposed by Israelsen (2005).

$$SR = \frac{\overline{\left(R_p - R_f\right)}}{\sigma_p} \qquad \boxed{2}$$

3.4.2 Excess return

The excess return generated by each strategy was calculated to the industry portfolio return (measured by the IFIX) for the period between January 2012 and December 2020. For its calculation, the Shapiro-Wilks test rejected the hypothesis of normality at the level of 5% for the portfolios generated. Therefore, Mann-Whitney-Wilcoxon was applied to detect statistical significance or not. It was verified the null hypothesis of the excess return being equal or below 0, against the alternative hypothesis that it is superior to 0. Rejecting the null hypothesis indicates superior performance of the strategy to the passive strategy of buying the BR-REITs' index.

3.4.3 Three-factor model's alpha

The estimates for the alphas were obtained for the period between January 2012 and December 2020 by calculating the intercept of linear regressions performed using the least-squares method. Such regressions were evaluated based on equation 3. The Fama-French three-factor model is an extension of the CAPM. Since CAPM may not encompass all factors influencing an asset return, the Fama-French model describes asset returns through three factors: (i) market risk; (ii) the outperformance of small-cap companies relative to large-cap companies; and (iii) the outperformance of high book-to-market value companies versus low book-to-market value companies. We have used IFIX as the market index and we have used small minus big (SMB) and high minus low (HML) factors calculated by the Brazilian Center for Research in Financial Economics (Núcleo de Pesquisa em Economia Financeira [NEFIN]) of the University of São Paulo (Universidade de São Paulo [USP]).

$$R_{p,t} - R_{f,t} = \beta_1\left(R_{m,t} - R_{f,t}\right) + \beta_2\, SMB_t + \beta_3 HML_t + \alpha_p + \varepsilon_{p,t} \qquad \boxed{3}$$

CAPM and the models derived from it are formulated to evaluate assets performance in relation to the market portfolio. In the literature, stock market indexes are commonly used as proxies for market portfolio since they encompass several different economic sectors. Nevertheless, no market index in Brazil encompasses BR-REITs and stocks jointly, differently from the Standard & Poor's 500 (S&P 500) or the Center for Research in Securitiy Prices (CRSP) used by Chui et al. (2003). Therefore, although other Brazilian indexes may be broader than IFIX, most of them do not include BR-REITs in their portfolios and some patterns of return of this equity class may not be observed in these portfolios. Having said that, the three-factor model evaluation was conducted to analyze intra-industry momentum and performance, which might limit our conclusions to the BR-REITs asset class.

4. RESULTS

Results are presented in four subsections. The first one shows the descriptive statistics of each portfolio formed by the winner or loser BR-REITs. The second subsection presents the results of momentum strategies that make use of these portfolios. This subsection is divided in two parts. The first one shows the long, short, and long-short strategies, which are presented as a starting point since these strategies are frequently presented in the literature as a common technic for the identification of the momentum effect, constituting a basic verification of the adequacy of the DY variation as a criterion for selecting assets in BR-REITs. The second part shows the long-biased strategies as alternatives that would generate higher returns. The third subsection shows the impacts of transaction costs and taxes on the performance of all strategies. The last subsection shows the results of a subperiod analysis, a robustness check of the results.

4.1 Descriptive Statistics of the Portfolios

Table 1 presents the descriptive statistics for the market indexes. It also presents the statistics for the 15 portfolios formed by winner BR-REITs. Winner BR-REITs are the ones which had the greatest DY variation in the formation period analyzed. Additionally, it presents descriptive statistics for the 15 portfolios formed by loser BR-REITs. Loser BR-REITs are the ones which had the lowest DY variation in the formation period analyzed.

The table is separated into panels A (market indexes), B (winners), and C (losers). On panel A, it is presented the value of 0.90% of the average monthly return for the IFIX in the period between January 2012 and December 2020, which can be compared to the average return of the winner and loser portfolios. In addition, it is presented the average return for CDI. The SD for both series is also presented. The SR for IFIX is 0.06. The SR of CDI does not need calculation since CDI corresponds to the risk-free rate itself.

Table 1
Descriptive statistics of the portfolios between January of 2012 and December of 2020

Panel A: market indexes								
Indexes	**Average return (%)**	**Standard deviation (%)**	**SR**	**Min. return (%)**	**Max. return (%)**			
CDI	0.70	0.28	NA	0.15	1.21			
IFIX	0.90	3.39	0.06	-15.85	10.63			
Panel B: winner portfolios								
Size 'j', formation period 'i'	**Average return (%)**	**SD (%)**	**SR**	**Min. return (%)**	**Max. return (%)**	**# of assets**	**Turnover (%)**	**Average Δ DY (%)**
10%, 1	1.53	4.40	0.19	-14.59	14.79	8	80.63	17.72
20%, 1	1.38	3.74	0.18	-15.06	11.89	15	74.18	11.40
30%, 1	1.31	3.52	0.17	-16.02	9.70	22	65.95	8.54
10%, 3	1.11	4.49	0.09	-18.11	16.36	8	45.23	9.85
20%, 3	1.28	3.82	0.15	-16.17	15.29	15	41.91	6.49
30%, 3	1.35	3.59	0.18	-16.82	10.91	22	36.94	4.90
10%, 6	1.14	4.78	0.09	-18.99	19.62	8	31.33	7.14
20%, 6	1.19	3.81	0.13	-14.95	15.29	15	28.64	4.76
30%, 6	1.35	3.59	0.18	-14.80	10.91	22	27.10	3.58
10%, 9	1.36	4.57	0.14	-18.27	16.36	8	24.96	5.99
20%, 9	1.18	3.72	0.13	-15.09	15.29	15	23.59	3.98
30%, 9	1.15	3.47	0.13	-15.72	10.91	22	21.95	3.00
10%, 12	1.07	4.44	0.08	-16.80	19.62	8	21.78	5.33
20%, 12	1.11	3.92	0.10	-15.24	15.29	15	21.93	3.51
30%, 12	1.03	3.69	0.09	-16.93	11.95	22	19.95	2.64

Table 1
Cont.

Panel C: loser portfolios								
10%, 1	0.13	4.38	0.13	-19.19	8.67	8	73.12	-12.12
20%, 1	0.33	3.56	0.13	-17.55	7.77	15	70.94	-8.72
30%, 1	0.51	3.44	0.06	-17.53	8.51	22	63.85	-6.90
10%, 3	0.15	4.16	0.13	-21.22	11.86	8	40.90	-8.58
20%, 3	0.26	3.69	0.12	-19.52	9.98	15	40.97	-6.05
30%, 3	0.38	3.36	0.10	-17.85	7.72	22	37.25	-4.75
10%, 6	0.22	4.21	0.12	-19.92	12.97	8	30.81	-6.76
20%, 6	0.50	3.61	0.06	-19.53	11.19	15	28.54	-4.71
30%, 6	0.51	3.32	0.06	-17.90	9.96	22	26.82	-3.67
10%, 9	0.49	4.31	0.05	-19.78	12.15	8	25.59	-5.84
20%, 9	0.51	3.53	0.06	-18.25	10.40	15	25.11	-4.03
30%, 9	0.59	3.30	0.04	-17.51	9.30	22	22.30	-3.13
10%, 12	0.58	4.08	0.03	-15.81	12.64	8	24.20	-5.21
20%, 12	0.70	3.52	0.00	-16.55	11.17	15	21.75	-3.60
30%, 12	0.63	3.45	0.02	-17.30	11.02	22	20.44	-2.79

Notes: *On panel A, the average return was obtained based on the arithmetic mean of the monthly returns of the indexes. The standard deviation (SD) was also calculated based on monthly data. The Sharpe ratio (SR) was calculated based on equation 2 for Índice de Fundos de Investimentos Imobiliários (IFIX) since the Brazilian Interbank deposit certificates rate (Certificado de Depósito Interbancário – CDI) is the risk-free rate itself. The minimum value corresponds to the lowest observed return. The maximum value corresponds to the highest return observed. On panels B and C, the size 'j' of the portfolios adopted values of 10%, 20%, and 30%. The formation period 'i' adopted values of 1, 3, 6, 9, and 12 months. A hundred and eight monthly return data were generated for each portfolio. The average return was obtained based on the arithmetic mean of the monthly returns of each 1/N portfolio formed based on the size and formation period. The SD was also calculated based on monthly data. The SR was calculated based on equation 2. The minimum value corresponds to the lowest observed portfolio return. The maximum value corresponds to the highest observed portfolio return. As the total number of BR-REITs varied throughout the analysis and the definition of size 'j' is given as a percentage of this value, on the column designed by # of assets the average number of BR-REITs is presented as the arithmetic mean of the number of BR-REITs in each portfolio in each month. The turnover rate was calculated as an average of the monthly turnover rate, so it must be interpreted as the percentage of the assets that are new to the portfolio. The dividend-yield (DY) variation, in turn, is presented as the monthly average of the arithmetic mean of the DY variation of the portfolio.*
NA = not available.
Source: *Elaborated by the authors.*

In the period between January 2012 and December 2020, 108 monthly return data were generated for each winner and loser portfolio. Panels B and C present the average returns, the SDs, the adjusted SR, the extreme values, the average number of BR-REITs each month in the portfolios, and the average of the past DY variation of each portfolio. The last indicator corresponds to how much, on average, BR-REIT's DY variated in the 'i' months before the one in which such portfolio was chosen.

First, it is possible to observe that all the portfolios composed of winner BR-REITs had average returns greater than that of the IFIX. In turn, all portfolios formed by loser BR-REITs showed lower average returns than the index. This is evidence that the criterion for selecting assets used is able to identify not only the next winners, but also the next losers, on average. The statistical significance of this result and the possibility of creating investment strategies that beat the BR-REITs' industry is evaluated in the following subsection.

It was not possible to identify different SDs between winners and losers. Although that, the risk-adjusted performance, measured by the SR presented on panel B, indicates positive values for all the winner portfolios. In turn, the value of SR had to be adjusted as proposed by Israelsen (2005), since negative values for the returns were found for the portfolios on panel C. This is another good evidence that DY variation might be a useful criterion for selecting assets in this industry.

Turnover rates were computed for each portfolio. It represents the percentage of BR-REITs that are new in a portfolio each month. Table 1 presents the arithmetic mean of the turnover rates during the period of analysis. Results show that smaller portfolios had greater turnover rates, so being subject to larger impacts of transaction

costs. This result also presents evidence that loser and winner ends were often composed of different BR-REITs.

The average DY variation shows how much, on average, the DY has variated in each portfolio. For example, for the winner portfolio with j = 30% and i = 3, there was a monthly 4.90% dividend growth during the formation period (3 months, in this case). This totals an average growth of 15.43% in three months for each BR-REIT that constituted the portfolio.

4.2 Performance of Momentum Strategies

4.2.1 Long, short, and long-short strategies

The previous results lead to the following analyses. By having identified different performances of portfolios composed by winner and loser BR-REITs, it is relevant to investigate the possibility of developing strategies based on momentum that outperform the BR-REITs' index, but with different risk profiles.

Long strategies correspond to buying winner portfolios with 100% of the capital, what generates the same returns as on Panel B of Table 1. Short strategies correspond to selling an amount of loser portfolios corresponding to 100% of the capital, and, so, obtaining 100% of the capital in leverage. In order to maintain 100% of the capital invested it is necessary to buy 100% of CDI and 100% of IFIX. The long-short strategies correspond to buying winner portfolios and selling loser ones by the same amount of 100% of the capital, and, so, obtaining 100% of the capital in leverage. In order to maintain 100% of the capital invested, it is necessary to buy 100% of CDI.

Buying the winner portfolios constitutes a conservative strategy that can be adopted by the unsophisticated investor. Short selling the loser portfolio, on the other hand, constitutes a leveraged strategy and it depends on liquidity issues. Long-short also constitutes a leveraged strategy and the bets are doubled, since the investor buys a potential winner portfolio and sells a potential loser portfolio. Notwithstanding, the long-short strategy can be considered a neutral strategy, since it does not depend on market positive returns to be profitable: it can return a positive performance both in cases of market declines or rises, constituting an interesting alternative that bets on the selection criterion and not on the market itself.

Table 2 shows the monthly average excess returns and monthly alphas obtained in the period of analysis with the following strategies: (i) buying the 15 winner portfolios (W); (ii) selling 15 loser portfolios (-L); and (iii) elaboration of 15 two-way strategies buying the winner portfolios, and selling the loser (W-L).

Table 2
Performance of long, short, and long-short strategies between January of 2012 and December of 2020

Panel A: excess returns relatively to IFIX (%)							
j	**Strategy**	**i =**	**1**	**3**	**6**	**9**	**12**
10	W		0.63***	0.21	0.24	0.47*	0.18
	L		0.57	0.55	0.49	0.22	0.12
	W-L		1.20***	0.76*	0.73**	0.68*	0.30
20	W		0.49***	0.38*	0.29*	0.28	0.21
	L		0.38	0.44	0.21	0.20	0.01
	W-L		0.86***	0.82**	0.50	0.48	0.21
30	W		0.41***	0.46***	0.45***	0.26*	0.14
	L		0.20	0.33	0.19	0.11	0.08
	W-L		0.61**	0.78**	0.64*	0.37	0.21
Panel B: alphas relatively to IFIX (three-factor model) (%)							
j	**Strategy**	**i =**	**1**	**3**	**6**	**9**	**12**
10	W		0.69**	0.29	0.35	0.58**	0.28
	L		0.85***	0.80***	0.68**	0.40	0.33
	W-L		1.54***	1.09***	1.03***	0.98***	0.61*
20	W		0.54**	0.47**	0.38*	0.36*	0.28
	L		0.59***	0.64***	0.37**	0.37**	0.15
	W-L		1.14***	1.11***	0.75***	0.73***	0.44*

Table 2
Cont.

Panel B: alphas relatively to IFIX (three-factor model) (%)							
j	**Strategy**	**i =**	**1**	**3**	**6**	**9**	**12**
30	W		0.48***	0.54***	0.52***	0.34**	0.22
	L		0.38***	0.51***	0.34**	0.26*	0.25*
	W-L		0.86***	1.05***	0.87***	0.60***	0.46**

Notes: *The indicated strategy always refers to buying the winner portfolio, selling the loser portfolio, or buying the winner portfolio and selling the loser portfolio, considering the corresponding parameters of size 'j' as a percentage of the total number of eligible Brazilian real estate investment trusts (BR-REITs) and formation period in months 'i'. The market portfolio was represented by Índice de Fundos de Investimentos Imobiliários (IFIX). All performance measures are computed monthly.*
L = short; W = long; W-L = long-short.
, **, * = significance at 10%, 5%, and 1%, respectively.*
Source: *Elaborated by the authors.*

Table 2 shows on panel A that, in the 108 months from January 2012 to December 2020, all strategies generated positive excess return. These values were submitted to the Mann-Whitney-Wilcoxon test to evaluate the null hypothesis that they are equal or below 0 against the alternative hypothesis that these values would be greater than 0. Results provide evidence that the DY variation can be used as a criterion for selecting assets to generate positive performances from both the long and short ends.

In the same way, panel B shows that all strategies also generated positive alphas. The intercepts of the linear regression obtained from equation 3 were evaluated under the null hypothesis that they are equal or below 0 against the alternative hypothesis that these values would be greater than 0. Again, most of the results on panel B showed to be statistically significant. These results reinforce our findings in favor of the usage of the DY variation as a criterion for selecting winners and losers, even when using a measure adjusted to risk.

By analyzing panels A and B, it can be observed that the magnitude of both the excess returns and alpha tend to decrease as the formation period in months (parameter 'i') increases. This means that strategies that make use of portfolios in which the past DY variation is calculated considering larger intervals of months generate lower returns. So, the highest returns were obtained with portfolios in which the DY variation is calculated in relation to the prior month ('i' = 1 month), indicating that in the short-term effects are better observed. On the other hand, with larger formation periods, portfolios end up obtaining lower excess returns and alphas relatively to the main index (IFIX). This effect is in line with the findings of the related literature. Jegadeesh and Titman (1993) showed that longer formation periods tended to present inferior momentum performance, which they assume happens because of reversals. Chui et al. (2003) corroborate these findings in American REITs. The same trend is observed in our results.

The analysis of the portfolio size (parameter 'j'), in turn, shows that, as it increases, considering percentages of the total number of eligible BR-REITs, the excess returns and alphas tend to decrease. This is expected, after all, with greater diversification, there may be lower returns, but which, when adjusted for risk, still offer competitive performances. These results also corroborate the findings of the related literature. Jegadeesh and Titman (1993) show that momentum tends to be more relevant in assets ranked at ends furthest from the median.

In general, results allow the identification of momentum associated with higher DY variation. This result follows the findings of Hung and Glascock (2008) findings on this relationship, who show that momentum in American REIT was associated with higher DY from 1992 to 2008. Also, results corroborate the findings of Guimarães (2013) who shows that the momentum effect is present in the BR-REITs' industry. The results presented from this point on follow the same patterns observed in this section, following the findings of the literature in which this paper is based, which gives consistency and solidity to the findings.

4.2.2 Long-biased strategies

Long-biased strategies mean that the final exposure to the market is positive. Since former results showed that it is possible to develop strategies based on winner and loser portfolios, the present analysis, therefore, lends itself to providing additional information on what would have been the above-market return obtained with the adoption of slightly riskier strategies.

Table 3 shows the monthly average excess returns and monthly alphas obtained in the period of analysis for three different long-biased strategies. The first is the 1.1W-0.1L strategy, which means buying the winner portfolio with 100% of the capital plus an extra 10% of leverage. The leveraged strategy makes use of the 10% of capital obtained with the short selling of the loser portfolio. The strategies 1.5 W-0.5 L and 2.0 W-1.0 L were also analyzed.

Table 3
Performance of long-biased strategies between January of 2012 and December of 2020

Panel A: excess returns relatively to IFIX (%)							
j	**Strategy**	**i =**	**1**	**3**	**6**	**9**	**12**
10	1.1 W-0.1 L		0.77***	0.30	0.34	0.55*	0.23
	1.5 W-0.5 L		1.33***	0.69**	0.70*	0.90**	0.42
	2.0 W-1.0 L		2.03***	1.16**	1.17**	1.34**	0.67*
20	1.1 W-0.1 L		0.59***	0.48**	0.36**	0.35*	0.25
	1.5 W-0.5 L		1.01***	0.89***	0.64**	0.61**	0.41
	2.0 W-1.0 L		1.54***	1.40***	0.99***	0.95**	0.61*
30	1.1 W-0.1 L		0.49***	0.55***	0.53***	0.31*	0.18
	1.5 W-0.5 L		0.81***	0.94***	0.87***	0.54***	0.34*
	2.0 W-1.0 L		1.21***	1.43***	1.28***	0.82***	0.54**
Panel B: alphas relatively to IFIX (three-factor model) (%)							
j	**Strategy**	**i =**	**1**	**3**	**6**	**9**	**12**
10	1.1 W-0.1 L		0.84**	0.40	0.45	0.68**	0.34
	1.5 W-0.5 L		1.46*	0.84*	0.87*	1.07**	0.58
	2.0 W-1.0 L		2.23***	1.38**	1.39**	1.56**	0,89
20	1.1 W-0.1 L		0.66***	0.58**	0.46*	0.43*	0.32
	1.5 W-0.5 L		1.11***	1.03***	0.76**	0.72**	0.50
	2.0 W-1.0 L		1.68***	1.58***	1.13**	1.08**	0.72*
30	1.1 W-0.1 L		0.57***	0.65***	0. 61***	0.40**	0.26
	1.5 W-0.5 L		0.91***	1.07***	0.96***	0.64***	0.45*
	2.0 W-1.0 L		1.34***	1.59***	1.39***	0.94***	0.68*

Notes: *The indicated strategy always refers to buying the winner portfolio, selling the loser portfolio, or buying the winner portfolio and selling the loser portfolio, considering the corresponding parameters of size 'j' as a percentage of the total number of eligible Brazilian real estate investment trusts (BR-REITs) and formation period in months 'i'. The market portfolio was represented by Índice de Fundos de Investimentos Imobiliários (IFIX). All performance measures are computed monthly.*
L = short; W = long; W-L = long-short.
, **, * = significance at 10%, 5%, and 1%, respectively.*
Source: *Elaborated by the authors.*

The same trends observed for the formation period in months (parameter 'i') on Table 2 can be observed on Table 3. The magnitude of both the excess returns and alpha tend to decrease as the DY variation is calculated in larger intervals of months and the highest returns were obtained with portfolios in which the formation period 'i' equals one month.

The analysis of the size of the portfolios (parameter 'j') also follows the trend observed on Table 2. The excess returns and alpha tend to decrease as the size of the portfolios, calculated as percentages of the total number of eligible BR-REITs, increases and the highest returns were generated by portfolios in which the size 'j' equals 10%.

With the adoption of these higher-risk leveraged portfolios, returns tend to be higher when compared to less bold strategies such as long or even long-short. Noteworthy are the returns observed for the 2.0 W-1.0 L portfolio, which indicate an excess return of up to 2.03% per month for the strategy in which the size of the portfolio 'j' equals 10% of the total number of eligible BR-REITs and the formation period 'i' equals 1 month.

4.3 Impacts of Transaction Costs and Taxes

4.3.1 Long, short, and long-short strategies

To measure the real profitability that would have been obtained with the adoption of such strategies in the period, we have incorporated transaction costs and taxes. Transaction costs were recorded at a total percentage of 0.0300% that levied on the total financial value of each purchase or sale, 0.0050% referring to trading costs, and 0.0250% referring to settlement costs paid to B3. Income tax on portfolio liquidation was recorded at the end of each month at the rate of 20% when the profit generated by the strategies was calculated to be positive.

Table 4 shows the monthly average excess returns and monthly alphas obtained in the period of analysis and presents the impacts of transaction costs and taxes, which are observed with the decrease of excess returns and alphas of all strategies in relation to Table 2. The trends previously observed for the different formation periods in months and sizes as percentages of the number of BR-REITs (parameters 'i' and 'j') hold: when they increase, smaller returns are obtained.

As the portfolios have a constant holding period of one month, the payment of taxes on profits calculated on the settlement of operations could have potentially decreased returns. However, this was not the case on Table 4, evidencing that the returns obtained by the portfolios were not exclusively due to price returns. The fact that returns can also be attributed to dividends is what made it possible not to burden the strategies excessively since this part of the return is exempted from paying taxes. The importance of dividends on the returns of BR-REITs is evidence of the adequacy of the DY variation as an important measure of past performance to be considered in momentum strategies.

Table 4

Impacts of transaction costs on long, short, and long-short strategies between January of 2012 and December of 2020

Panel A: excess returns relatively to IFIX (%)							
j	**Strategy**	**i =**	**1**	**3**	**6**	**9**	**12**
10	W		0.49**	0.10	0.11	0.34	0.04
	L		0.35	0.32	0.28	0.06	-0.04
	W-L		0.90**	0.54	0.51	0.48	0.08
20	W		0.37**	0.25	0.19	0.17	0.08
	L		0.21	0.26	0.07	0.06	-0.12
	W-L		0.59**	0.55	0.30	0.29	0.06
30	W		0.28**	0.33***	0.33**	0.14	0.02
	L		0.06	0.17	0.06	-0.02	-0.04
	W-L		0.36	0.51	0.40	0.20	0.07
Panel B: alphas relatively to IFIX (three-factor model) (%)							
j	**Strategy**	**i =**	**1**	**3**	**6**	**9**	**12**
10	W		0.53*	0.18	0.22	0.45	0.14
	L		0.61**	0.56**	0.46*	0.24	0.16
	W-L		1.23***	0.86**	0.81**	0.77**	0.38
20	W		0.43**	0.34*	0.28	0.25	0.16
	L		0.42**	0.46**	0.22	0.23	0.03
	W-L		0.86***	0.83***	0.54**	0.54**	0.28
30	W		0.35**	0.41*	0.40***	0.22	0.10
	L		0.24*	0.35**	0.21	0.13	0.12
	W-L		0.61***	0.76***	0.62***	0.43**	0.32

Notes: *The indicated strategy always refers to buying the winner portfolio, selling the loser portfolio, or buying the winner portfolio and selling the loser portfolio, considering the corresponding parameters of size 'j' as a percentage of the total number of eligible Brazilian real estate investment trusts (BR-REITs) and formation period in months 'i'. The market portfolio was represented by Índice de Fundos de Investimentos Imobiliários (IFIX). All performance measures are computed monthly. Transactions costs and taxes were considered.*

L = short; W = long; W-L = long-short.

, **, * = significance at 10%, 5%, and 1%, respectively.*

Source: *Elaborated by the authors.*

Thus, the results of Table 4 corroborate the hypothesis that the strategies that use the portfolios formed by winners and losers based on DY variation can, even with the consideration of transaction costs and taxes, seize returns from BR-REITs' industry's inefficiencies.

It is important to highlight that there are long strategies, which could have been adopted by more conservative investors, that would have generated monthly returns of 0.49% above the IFIX (size 'j' equals 10% of the total number of eligible BR-REITs and formation period in months 'i' equals 1). This constitutes a strategy that can largely outperform the BR-REITs' index and still maintain risks similar to the risks of the index, as shown on Table 1.

4.3.2 Long-biased strategies

Finally, to measure the real profitability that would have been obtained with the adoption of long-biased strategies in the period, we proceeded in the same way as in the previous subsection. Table 5 shows the monthly average excess returns and monthly alphas obtained in the period of analysis.

As expected, the impacts of transaction costs are observed with the decrease of excess returns and alphas of all strategies in relation to Table 3. All long-biased strategies showed both positives excess returns and alphas. The trends previously observed for the different formation periods in months and sizes as percentages of the number of BR-REITs (parameters 'i' and 'j') hold: when they increase, smaller returns are obtained. As before, monthly rebalancing did not burden the return of the strategies due to excessive transaction costs or taxation.

Table 5
Impacts of transaction costs on long-biased strategies between January of 2012 and December of 2020

Panel A: excess returns relatively to IFIX (%)							
j	**Strategy**	**i =**	**1**	**3**	**6**	**9**	**12**
10	1.1 W-0.1 L		0.61**	0.18	0.19	0.42	0.07
	1.5 W-0.5 L		1.09***	0.49	0.49	0.70*	0.20
	2.0 W-1.0 L		1.66***	0.89**	0.85*	1.05**	0.34
20	1.1 W-0.1 L		0.46**	0.33*	0.24*	0.22	0.11
	1.5 W-0.5 L		0.79***	0.67**	0.47*	0.43*	0.22
	2.0 W-1.0 L		1.18***	1.05***	0.75**	0.70**	0.35
30	1.1 W-0.1 L		0.34**	0.40***	0.39***	0.18	0.05
	1.5 W-0.5 L		0.57***	0.69***	0.64***	0.35*	0.16
	2.0 W-1.0 L		0.86***	1.05***	0.93***	0.57**	0.30
Panel B: alphas relatively to IFIX (three-factor model) (%)							
j	**Strategy**	**i =**	**1**	**3**	**6**	**9**	**12**
10	1.1 W-0.1 L		0.67**	0.27	0.31	0.54*	0.19
	1.5 W-0.5 L		1.121***	0.64	0.65	0.87**	0.36
	2.0 W-1.0 L		1.85***	1.11*	1.07*	1.26**	0.56
20	1.1 W-0.1 L		0.53**	0.43**	0.34	0.30	0.19
	1.5 W-0.5 L		0.90***	0.81***	0.59*	0.54*	0.31
	2.0 W-1.0 L		1.33***	1.23***	0.89**	0.84**	0.46
30	1.1 W-0.1 L		0.42**	0.49***	0.47***	0.27*	0.13
	1.5 W-0.5 L		0.68***	0.82***	0.73***	0.46**	0.27
	2.0 W-1.0 L		0.99***	1.21***	1.04***	0.69**	0.44

Notes: *The indicated strategy always refers to buying the winner portfolio, selling the loser portfolio, or buying the winner portfolio and selling the loser portfolio, considering the corresponding parameters of size 'j' as a percentage of the total number of eligible Brazilian real estate investment trusts (BR-REITs) and formation period in months 'i'. The market portfolio was represented by Índice de Fundos de Investimentos Imobiliários (IFIX). All performance measures are computed monthly. Transactions costs and taxes were considered.*
L = short; W = long; W-L = long-short.
, **, * = significance at 10%, 5%, and 1%, respectively.*
Source: *Elaborated by the authors.*

It is important to highlight that, as the results on Table 3, there is an expressive magnitude of returns observed on long-biased strategies. As a highlight, the 2.0 W-1.0 L showed expressive monthly excess returns ranging from 0.86% to 1.66%. Nonetheless, the adequacy of one or another strategy shall be evaluated by each investor.

4.4 Subperiod Analysis

In order to verify if our results are maintained in different scenarios, we have ran a sub-period analysis. Considering the same panel data between January 2016 and December 2020, we have formed winner and loser portfolios for this period. This subperiod is of major importance since it does not encompass the period from 2012 to 2015, which had an important development of the Brazilian real estate industry. Also, this subperiod is marked by higher volatility in Brazilian financial market due to political and economic instability.

Table 6 shows the monthly average excess returns and monthly alphas obtained in the subperiod of analysis. By analyzing panel A, it is possible to identify that 19 of the strategies generated negative excess returns. These results do not follow the trends found in the prior analysis. Also, most of the results are not statistically significant.

Although that, by analyzing panel B, we see that only 4 strategies delivered negative alphas and that most of the results are significantly different from 0. Therefore, alphas' results corroborate the findings of the previous sections.

Table 6
Performance of long, short, and long-short strategies between January of 2016 and December of 2020 considering the impact of transaction costs

Panel A: excess returns relatively to IFIX (%)							
j	**Strategy**	**i =**	**1**	**3**	**6**	**9**	**12**
10	W		-0.03	-0.16	-0.15	0.33	-0.18
	L		0.41	0.29	0.25	0.12	-0.13
	W-L		0.44	0.22	0.18	0.46	-0.26
20	W		0.13	0.09	0.12	0.05	0.05
	L		0.04	0.19	-0.07	-0.02	-0.25
	W-L		0.19	0.29	0.07	0.05	-0.15
30	W		0.07	0.19	0.22	0.04	-0.06
	L		-0.16	-0.04	-0.14	-0.24	-0.23
	W-L		-0.05	0.17	0.12	-0.13	-0.21
Panel B: alphas relatively to IFIX (three-factor model) (%)							
j	**Strategy**	**i =**	**1**	**3**	**6**	**9**	**12**
10	W		0.08	-0.16	-0.21	0.33	-0.12
	L		1.01***	0.88***	0.88***	0.81**	0.46
	W-L		1.18**	0.83*	0.75	1.12**	0.37
20	W		0.25	0.17	0.18	0.12	0.11
	L		0.60***	0.77***	0.53**	0.56***	0.33
	W-L		0.86**	0.95***	0.72**	0.68**	0.48
30	W		0.17	0.28*	0.28*	0.12	-0.02
	L		0.43**	0.54***	0.43***	0.31*	0.35*
	W-L		0.61**	0.82***	0.72***	0.48*	0.38

Notes: *The indicated strategy always refers to buying the winner portfolio, selling the loser portfolio, or buying the winner portfolio and selling the loser portfolio, considering the corresponding parameters of size 'j' as a percentage of the total number of eligible Brazilian real estate investment trusts (BR-REITs) and formation period in months 'i'. The market portfolio was represented by Índice de Fundos de Investimentos Imobiliários (IFIX). All performance measures are computed monthly. Transactions costs and taxes were considered.*
L = short; W = long; W-L = long-short.
, **, * = significance at 10%, 5%, and 1%, respectively.*
Source: *Elaborated by the authors.*

An important observation is that in the subperiod analyzed short strategies presented higher returns. Considering the formation period of one month, it is possible to note that all strategies delivered performance

superior to the BR-REITs' index, holding the findings that show that in the short term, DY variation momentum is prevalent.

So, considering alpha as a measure of performance, results are maintained in the subperiod. This is of major importance because, although the selected portfolios might not have exceeded the BR-REITs' index in terms of return, when considering the risk to which these portfolios were submitted, it is possible to assume that they overperformed the industry's portfolio.

5. CONCLUSION

The main result of this paper is identifying that the usage of the DY variation as a criterion for asset selection in BR-REITs may deliver abnormal results. Results show that winner (and loser) portfolios, composed by the BR-REITs that presented larger (respectively, smaller) DY variations performed better (respectively, worse) than the industry's portfolio measured by the IFIX. Several strategies that buy winners and/or sell losers were evaluated in comparison to the industry's portfolio. We showed that these strategies were able to benefit from both ends of the DY variation ranking. Also, we showed that the observation of irregularities on dividend payments and prices that generate variations in the DY can be a guide to anticipate possible inefficiencies or departure from fundamentals.

These findings are important because the literature has focused on the study of BR-REITs from a risk-return perspective, based on the efficient-market hypothesis. The observation of inefficiencies giving rise to a predictor in this market segment is relevant and innovative, which means that this study may pave a fruitful line of further research and practical applications.

It is important to state that the results are restrict to the sample analyzed and that they were obtained with an intra-industry analysis. Also, we did not control for the number of assets in which a BR-REIT invests neither for the kind of investment a BR-REIT makes (i.e., a BR-REIT can focus on real estate debt, on real estate properties or even on developing new real estate opportunities).

Two limitations of this work are worth mentioning. In the analyzed period, short-selling BR-REITs was not possible. Therefore, the analysis performed with short strategies is only illustrative of what returns these strategies would have generated for the investors. Also, BR-REITs' liquidity is a concern, which brings some limitations for large investor to implement any strategy. The substantial excess returns and alphas obtained from the analyzed strategies, specifically the long-short and long-biased ones, are evidence that the DY variation is useful as a criterion for selecting assets to outperform the industry's index to a reasonable degree. The results found are of interest of REIT investors. The use of the strategy presented by this paper by investors of other asset class must be scrutinized by further and specific analysis. Over and above that, the strategies analyzed are of simple elaboration and made use of variables available to any investor, so that the results of this paper shall interest investors in general and, more specifically, institutional investors and portfolio managers who operate funds of BR-REITs. Thus, this paper opens a promising path for investors to pioneer the application of the DY variation as selection criterion of BR-REITs in momentum strategies.

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