

Predictive power of Brazilian equity fund performance using R^2 as a measure of selectivity*

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ABSTRACT

This paper aimed to investigate the impact of levels of selectivity on the performance of equity funds using a methodology applied for the first time ever (as far as we know) in the Brazilian market. As an indicator of the activity level of a fund, we proposed the coefficient of determination (R^2) of the regression of its returns over market returns. In total, 867 funds were analyzed in the period between November 2004 and October 2014. The hypothesis tested is that more selective funds perform better to compensate for their higher operating costs. This hypothesis was confirmed in the Brazilian market. Dynamic equally-weighted portfolios of funds were simulated, according to their past R^2 and alphas, with monthly rebalancing and 12-month moving windows. The portfolio of the most selective funds had a Sharpe ratio of 0.0494, on a monthly basis, while the portfolio of the least selective funds had a Sharpe ratio of -0.0314. Performance was also higher in evaluations involving excess returns, Jensen's alpha, and accumulated returns, as well as when compared to randomly selected portfolios. Moreover, past performance (as measured by Jensen's alpha) was also a predictor of future performance. Particularly, the portfolio composed by funds with a higher past alpha and lower past R^2 presented a Sharpe ratio of 0.1483 and a Jensen's alpha of 0.87% (significant at 1%), while the one composed of funds with a lower past alpha and lower activity level presented a Sharpe ratio of -0.0673 and an alpha of -0.32% (also significant at 1%).

Keywords: selectivity of equity funds, financial brazilian market, predictive power, Sharpe ratio, Jensen's alpha.

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1. INTRODUCTION

An important step in deciding to invest in variable income is selecting the assets that will form part of a portfolio. In the case of investment funds, the choice could be between passive funds that accompany indices or active funds that try to compensate for a higher cost style with better returns. According to a piece from *The Economist* (*Fund management will invest for food: like books and music, the investment industry is being squeezed*, 2014), total global assets under active management currently exceed 50 trillion dollars. A plausible estimate of the difference in average fees and costs between active and passive funds is 1% of total assets under management (Daniel, Grinblatt, Titman, & Wermers, 1997). This means that active management generates additional costs of approximately half a trillion dollars annually and most of this can be associated with efforts to select the assets that will form part of the portfolios. By how much do these funds systematically achieve gross earnings that exceed this amount? Can a fund's level of activity indicate higher expected returns? If so, how can funds be selected using levels of activity in order to maximize the chances of obtaining the best returns?

Various studies have proposed simple or sophisticated methods for obtaining these answers. This study aims to apply, for the first time ever in the Brazilian market (as far as we know), the methodology from Amihud and Goyenko (2013), authors who investigated the effectiveness of one method for selecting US equity funds based on their levels of activity or selectivity, under the hypothesis that greater activity would generate greater returns.

The method assumes two relationships: the first, that funds that select their assets more present better performance, and the second, that these more selective funds show a path of returns that is less correlated with that of the market. These assumptions lead to measuring level of selectivity based on the coefficient of determination (R^2) of the linear regression of these funds' excess returns compared with excess market returns. The less market results can explain the variability of a fund's returns, the greater the selectivity of the fund, and therefore the better its performance will be. In other words, considering that market benchmarks are only fundamentally exposed to systematic risk, the more effective a fund's exposure to idiosyncratic risks, the better its average performance will be. This therefore concerns a method that requires normally available information in order to facilitate its application.

Amihud and Goyenko (2013) analyzed the monthly

returns of 2,460 funds with equity of at least 15 million dollars, covering 1988 to 2010. The moving window for calculating the R^2 and performance was 24 months. Performances were measured using the alpha generated based on the regressions using the four factors model, known here as Fama, French, and Carhart (FFC), explained by Carhart (1997) and developed based on the Fama and French (1993) model. As a robustness test, the Cremers, Petajisto, and Zitzewitz (2012) model was also used, known here as CPZ. First, the performances of portfolios containing funds with different levels of R^2 and alphas were compared. Then, using regression models, the ability to predict a fund's performance using its R^2 , calculated based on its past performance, was verified. Finally, also using regression models, the main determinants of the R^2 of the funds were calculated, by investigating the explanatory power of characteristics such as time under current management, size, age, expenses, turnover, and style.

The results from Amihud and Goyenko (2013) confirm these relationships and allow it to be concluded that there is effectiveness in the methodology. The portfolio of funds with the lowest R^2 and highest performance presented significantly better returns than those of the other portfolios. Moreover, the relationship between the R^2 and some fund characteristics reveals that it is a consistent measure of selectivity, with time under current management, expenses, and size being the variables that influence it the most.

In this context, this study proposes to apply this asset selection methodology in the Brazilian equity funds market. The quantity, size, and diversity of this class of funds have significantly evolved in the country over the last decades and they represent an important investment activity. Based on the relationship with the performance of the most well-known stock market index of the Brazilian stock exchange [Bovespa index (Ibovespa)] and a proxy for the risk-free interest rate, the level of selectivity of these funds is measured and the hypothesis that more selective funds present better performance is tested.

Various international studies have sought to verify whether more selective funds in fact present better returns, using the funds' positions in each asset. Among these, worth mentioning are those from Brands, Brown, and Gallagher (2005), Cremers, Ferreira, Matos, and Starks (2011), Cremers and Petajisto (2009), and Kacperczyk, Sialm, and Zheng (2005). These studies show that, in general, the greater the divergence between these funds'

positions and the composition of market indices, the greater the performance presented. The study from Daniel et al. (1997), in turn, concluded that the difference in performance was correlated with fund expenses. Kacperczyk and Seru (2007) showed that funds that invest in assets based on fundamental information that differs from analyst expectations perform better.

In Brazil, some papers have been developed in order to analyze the performance of funds with active management and to identify the variables with the greatest explanatory power with regards to the performance of these funds. Castro and Minardi (2009) developed a study comparing the performances of Brazilian funds classified as active and passive, covering 1996 to 2006. The results indicated that active management, although it is preferred by investors, does not generally present any net or even gross income that is greater than that of passive funds, leading to the belief that the search for market inefficiencies did not bring the returns expected in the Brazilian market in the period. In other words, security prices would already reflect all existing information up to the point at which marginal benefits from its use would not exceed the marginal costs. With a different result, Rochman and Eid (2006) produced a similar paper comparing 699 publicly-traded Brazilian

funds, covering 2001 to 2006, and the results showed that for multimarket equity funds active management would add investor value.

Malacrida, Yamamoto, Lima, and Pimentel (2007) analyzed the performance of Brazilian funds under active management in relation to the Ibovespa, with data on 66 funds covering 1999 to 2006. It was possible to determine that performances can be very different between funds in the short and long terms, but that almost 40% of the funds presented a consistent performance in the period, which would indicate that active management may have been advantageous for these funds.

This article is organized in the following way: the next section carries out a review of the literature regarding the methodology replicated for the Brazilian market, as well as the other ways of measuring levels of activity and the applicability of asset pricing models in Brazil. Then, the adopted methodology is described, as well as the criteria for and characteristics of the sample of funds used. The next section presents and discusses the results from applying the methodology, section 5 presents some important robustness tests, and section 6 concludes the paper.

2. LITERATURE REVIEW

2.1 Predicting performance based on the R^2

This study is based on the methodology created by Amihud and Goyenko (2013) for predicting fund performance based on level of selectivity. The methodology supports the hypothesis that the greater a fund's level of activity is, the better its performance will be. Performance is measured by the alpha of the regression of its excess returns using the FFC four factors model and also the four factor CPZ model as a robustness test. The methodology's originality involves measuring level of activity using the R^2 of the regression of excess fund returns based on the FFC model. According to this method, the lower the R^2 of a fund is in this regression, the higher its level of activity or selectivity.

In order to avoid using a model based on a spurious relationship, Amihud and Goyenko (2013) compared their methodology with other methods of evaluating fund selectivity that use the compositions of fund portfolios as information. One of these methodologies is represented by the characteristic selectivity indicator from Daniel et al. (1997). This metric forms part of a performance

measure that compares each share in a fund's portfolio with one of 125 different passive benchmarks. These benchmarks are portfolios composed of shares with a similar size, book-to-market, and return in the previous year. These three measures were adopted as they are the best *ex-ante* predictors of return on shares, according to previous studies (Daniel et al., 1997; Fama & French, 1992; Jegadeesh & Titman, 1993). Fama and French (1992) simultaneously examined a series of variables and concluded that size and book-to-market are the ones that can explain the variations in expected transversal returns on shares. Subsequently, Jegadeesh and Titman (1993) described significant returns derived from the strategy of selling shares that have performed poorly in the past and buying those that have performed well. The selectivity characteristic of a fund is, therefore, the weighted average excess return on the fund's shares in relation to a passive portfolio composed of shares with the same characteristics.

Amihud and Goyenko (2013) regressed the selectivity indicator characteristic using the R^2 and other fund characteristics as explanatory variables. All of the

statistical models constructed by the authors included six important fund characteristics: (i) size, measured by net equity, (ii) expenses, measured by the percentage of administrative, management, and operating expenses in relation to net equity, (iii) turnover, measured by the lowest between total share sales or purchases in the last 12 months divided by average net equity in the period, (iv) age, measured by the difference in years between the observation date and the date on which a fund's shares were offered for the first time, (v) mandate, or time under current management, measured by the difference in years between the observation date and the date on which the fund management related to that observation assumed control, and finally, (vi) the style or type of fund. Styles were organized into nine categories: (i) aggressive growth, (ii) proceeds, (iii) growth, (iv) long term growth, (v) growth and proceeds, (vi) maximum capital gains, (vii) mid-cap, (viii) small cap, and (ix) micro-cap. The last three refer to the typical market value standard of the companies in which a fund focuses on investing, representing, respectively, mid-value, small, and very small companies.

The results from the regression of the selectivity characteristic based on the R^2 and fund characteristics showed that the R^2 can be considered as determinant of the level of fund selectivity. The model resulted in negative and significant coefficients for the R^2 , confirming its ability to measure selectivity.

Amihud and Goyenko (2013) created fund portfolios in accordance with their alphas and R^2 calculated based on the previous 24 months. This was organized by quintiles. Each month, each portfolio was adjusted to compose the funds with the R^2 and alphas that corresponded to each quintile. A higher average alpha was expected in the portfolio with a position for buying funds with a lower R^2 and higher alpha. Quintiles represented by portfolios containing funds with a higher R^2 or with a lower alpha should present successively lower returns. Using the sample of returns for 2,460 funds covering 1988 to 2010, the quintile with funds with the lowest R^2 and highest alpha presented a statistically significant return of 3.8% a year, greater than the average return from the other quintiles and thus confirming the stated hypothesis.

To examine the variables with the power to predict fund performance, their alphas were subjected to regression based on their R^2 and alpha relating to the previous month. The model also contemplated the six fund characteristics. The hypothesis is that the coefficient of the regression associated with the R^2 is negative and significant; that is, the lower a fund's R^2 , based on past evolution, the greater its performance in the subsequent period. The

results using the FFC model indicated that the lagged R^2 presents a significant and negative coefficient, confirming the hypothesis. Similar results occur for the transformed logarithm of R^2 and by altering the pricing model to CPZ.

After confirming the predictive power of a fund's performance based on its R^2 , Amihud and Goyenko (2013) sought to identify the effects of its characteristics on the R^2 . The aim was to identify the variables that best explain a fund's R^2 , and consequently its level of activity. For this, a regression model was constructed with R^2 as the dependent variable and these characteristics as independent variables. The characteristics that presented a significant coefficient were expenses, size (measured by net equity), and time under current management. Only the size variable presented a positive coefficient. The results indicated that funds with higher fees and costs tend to have a greater level of activity, and for this reason, a lower R^2 . Moreover, managers with less time tend to avoid non-systematic risks when they select their portfolios. The positive coefficient of the size variable allows for it to be said that smaller funds tend to risk more, accompanying the market less. The turnover and age variables did not present significant coefficients. The style of the funds also determined the R^2 : micro-cap, mid-cap, and aggressive growth type funds presented a low R^2 and small cap, growth and proceeds, growth, and long term growth funds presented a high R^2 .

2.2 Asset Pricing Models in Brazil

As mentioned, in order to measure a fund's level of activity, this study uses the R^2 from the regression of its excess returns based on excess Brazilian stock market returns. Moreover, we use the alpha (linear coefficient) from the same regression to measure fund performance. We chose the Capital Asset Pricing Method (CAPM) in both cases due to the fact that it is relatively simple and widely known and used, both in Brazil and abroad. There is no consensus with regards to the applicability of models such as Fama-French and its variants in the Brazilian market. Laes and Silva (2014), for example, indicate that results based on these models present problems of non-normality of residues, the presence of a correlation between the alphas of the funds in a sample, and the luck factor as a possible reason for better performance. The paper consisted of applying bootstrapping techniques in a sample of 812 funds covering 2002 to 2009 and it in fact showed that in a good number of cases the luck variable is the factor determining performance.

Other authors have developed attempts to improve existing models or define the most applicable to the Brazilian market. Milani, Ceretta, Barba, and Casarin

(2010) saw that the inclusion of better moments in the CAPM, in order to capture systematic kurtosis and asymmetry effects, is not of great relevance for improving the applicability of the model in Brazil. Oliveira, Mussa, and Gouvea (2011) tested the explanatory power of the CAPM, 3-Factor, and 4-Factor models in the Brazilian equity fund market, using data from 2002 to 2009, and concluded that none of these models presented good explanatory power for these funds' returns.

With a similar aim, Bellizia (2009) investigated the applicability of the CAPM for determining cost of own capital in Brazil. The model was chosen instead of others, such as arbitrage pricing theory (APT) and Fama-French, due to it being more widespread in Brazil. Most of the criticisms related to the APT model concern the inexistence of a well defined methodology for identifying the factors to be considered. In the case of Fama-French, it bears mentioning that the model was constructed based on empirical evidence in the US market and lacks theoretical support.

In a comparative study, Argolo, Leal, and Almeida (2012) tested the applicability of the Fama-French model in Brazil. The analysis covered the period from 1995 to 2007 and showed that, despite this model having a greater explanatory power than the CAPM, high averages and instability in the "high minus low" (HML) and "small minus big" (SMB) factors were found. Estimates of cost of own capital using the CAPM were more reasonable from a financial point of view. Moreover, the lack of a suitable number of liquid shares and a sufficiently long historic record make parametrization of the Fama-French model difficult.

Regardless of the controversial results from the multifactor models in the Brazilian market, we opted to use the FFC model as a robustness test in section 5 in order to make our results even more consistent and comparable with the original paper for the US market.

2.3 Other Measures of Investment Fund Level of Activity

Besides the methodology from Amihud and Goyenko (2013), there are others such as "active share", from

Cremers and Petajisto (2009), "industry concentration index", and "return gap", both from Kacperczyk et al. (2005).

Active share represents the sum of absolute errors between the position of each share in a portfolio of funds and the position in a related benchmark. According to Amihud and Goyenko (2013), the measure based on the R^2 is more direct, uses quickly available data, and does not require access to a fund's portfolio composition, which is often an unavailable piece of data. Calculating the most suitable benchmark for comparing can also be problematic. A fund that invests passively in two benchmarks would be incorrectly identified with a high level of activity according to active share. Amihud and Goyenko (2013) developed statistical tests between active share and R^2 , resulting in an average correlation of -0.45 between the indicators. This shows that, even sharing the proposal of measuring level of selectivity, each indicator incorporates information on funds that is not contemplated by the other. The authors also investigated whether including this indicator in the regression model for the funds' alphas would result in a loss in the significance of the R^2 . The funds' alphas were then regressed based on their R^2 , their active share, and their characteristics. Even in this model, the coefficient of the R^2 continued to be negative and significant, which shows that this metric contributes to predicting fund performance in addition to the suggested predictive power of active share.

The industry concentration index represents the sum of the squares of the deviations between the positions of different industries in a portfolio of funds and in a market portfolio. This measure basically has the same limitations discussed previously regarding active share.

Return gap is the difference between the return reported by a fund and the return of a benchmark portfolio that carries the same shares. In the same way they did with active share, Amihud and Goyenko (2013) included these last two indicators as explanatory variables in the regression for the funds' alphas based on their R^2 and their characteristics. Even after the inclusion, the coefficient of the R^2 remained significant and negative, leading to the same conclusion obtained in the tests using active share.

3. RESEARCH METHODOLOGY

In this section we present the criteria adopted to replicate the methodology from Amihud and Goyenko (2013) in the Brazilian market in order to predict fund performance based on a proxy for the level of selectivity of each fund.

3.1 Selectivity Measure Specification

In this paper the coefficient of determination R^2 was

$$R^2 = \frac{\text{Variance of model}}{\text{Total variance}} = 1 - \frac{\text{Variance of residuals}}{\text{Total variance}} \quad [1]$$

If this model represents a market portfolio, the R^2 measures the similarity between the performance paths of a fund and of this portfolio. The risk to which funds are exposed can be divided into systematic and non-systematic or idiosyncratic. Market portfolios, if they are sufficiently diversified, are only exposed to systematic risk. Therefore, from a financial point of view, the variance in the residues from the regression can be understood as the

used to measure the level of selectivity of the funds to be analyzed. This statistical measure, well established through classical analysis by linear regression [see, for example, Rao (1973)], indicates whether the model used in the linear regression is a good representation of the variable to be explained. In other words, it shows how much of the variance in the independent term, which in this case is excess fund returns, is explained by the model, as equation 1 shows.

idiosyncratic risk to which a fund is exposed. Amihud and Goyenko (2013) discuss this point, providing a good theoretical foundation and arguing that more selective funds have different paths of returns from the market portfolio and are more exposed to idiosyncratic risk. Consequently, they conclude that the R^2 can be adopted as an inverse measure of the level of activity of funds, as shown in equation 2.

$$R^2 = 1 - \frac{\text{Idiosyncratic risk}}{\text{Idiosyncratic risk} + \text{Systematic risk}} \quad [2]$$

The market portfolio in this paper was represented by the Ibovespa and the Interbank Deposit Certificate (CDI) was adopted as the proxy for the risk-free interest rate.

3.2 Composition of the Sample of Funds

The ten years between November 2004 and October 2014 were considered for the analysis. This period is understood to be sufficiently long, with periods of stability and periods of crises. Monthly time series of the returns and net equities of Brazilian funds classified as active were extracted from the Quantum Axis platform. The returns are net of administration fees. For each fund, its operating style was also obtaining according to the criterion created by the Brazilian Association of Financial and Capital Market Entities (Anbima, 2015). This extraction resulted in 1,296 Brazilian equity funds operating and with data available in November 2014, the time of extraction. The

Quantum Axis platform defines active equity funds as those with assets traded on stock exchanges or contracts traded on the future index and options market. These funds are also considered as equity funds according to the classification made by the Brazilian Securities and Exchange Commission (CVM). 399 funds classified as masters and 30 funds with an average net equity below one million reais were excluded, increasing the liquidity level of the sample and resulting in a sample of 867 funds.

In order to increase the effectiveness of the measure of level of selectivity using R^2 and guarantee a sample with accessible funds for the common investor, 189 funds were excluded from the sample that require a minimum investment above 100 thousand reais and 286 funds with a restricted, reserved, or exclusive target public. These exclusions resulted in a set of 392 funds. Additionally and as a robustness test, a simulation without these eliminations was carried out to evaluate the consistency

of the model. Moreover, again for robustness purposes, another scenario was generated that excludes 157 funds with investments abroad; investments abroad could generate a low R² without necessarily greater selectivity in the domestic market.

3.3 Pricing Model Specification

Both for determining the R² and the alpha, the CAPM was used in the base case and the FFC model as a robustness test. The CDI was adopted as a proxy for the risk-free interest rate and the Ibovespa as a proxy for market returns, due to them better representing alternatives for a conventional investor. For the additional three risk factors in the FFC model, we stuck rigidly to the methodology applied by Santos, Famá, and Mussa (2012).

Fund alphas and R² were calculated monthly based on the linear regression for their excess returns in relation to the CDI, using excess returns on the Ibovespa in relation to the CDI as an explanatory variable (and the three factors of FFC in the robustness test). The alpha

and R² for a particular month are thus results of the regression that uses a moving window with observations from the previous 12 months as a sample. This period is considered to be sufficient for verifying the correlation between fund performance and that of the Ibovespa and also makes the results more significant and the model more frugal. The first 12 months of the sample were the initial window for calculating the R² and alpha of the subsequent month, leading to a total of nine years, or 108 months, for constructing the portfolios of funds. Any fund that appeared during this nine-year period is only considered for constructing the portfolios 12 months after its inauguration, as only from here onwards can its R² and alpha series be estimated.

Observations with an R² below 0.5% or above 99.5% were excluded from the sample in order to eliminate outlier strategies, estimative errors, or pure indexers. With this a total of 39,057 observations were reached. Table 1 presents mean, median, minimum, and maximum values from the sample of funds used.

Table 1 Characteristics of the sample of funds used for the portfolio simulations

	R ² (%)		Alpha (% monthly)		Net equity (R\$ million)
	CAPM	FFC	CAPM	FFC	
Mean	75	86	0.2	0.0	83.82
Median	82	91	0.1	0.1	27.95
Minimum	1	2	-8.3	-10.4	0.22
Maximum	99	99	9.6	8.2	3,212.80

Note: coefficient of determination (R²) and alpha are calculated based on regressions using the Capital Asset Pricing Method (CAPM) or Fama, French, and Carhart (FFC) as pricing models, the Bovespa index as a proxy for market return, and the Interbank Deposit Certificate (CDI) as a proxy for the risk-free interest rate.

Source: Prepared by the authors.

3.4 Construction of Dynamic Fund Portfolios

To evaluate the influence of the R² on fund performance, hypothetical portfolios were constructed with equal weights and monthly updating of the funds that comprise the portfolio of each fund. In each month of the sample, five different fund portfolios are constructed based on their R². Each portfolio represents one quintile of the sample of funds. In the 1st quintile are the funds with the lowest recorded R² values and in the 5th quintile are those with the highest R² values. The same rule is adopted for the intermediate quintiles into which the other funds are allocated. The higher the quintile is in the order, the higher the R² of the component funds. The quintiles have the same number of funds, approximately (this occurs because the total number of funds in each month is generally not a multiple of five). As the sample contains only the funds

that are active at the end of the period, the quantity of funds available to compose the portfolios increases over time. Figure 1 shows the evolution in the quantity of funds that compose each quintile and subquintile.

The hypothesis to be tested is that the portfolio represented by the 1st quintile will present a better performance than that represented by the 2nd quintile, and so on. For a comprehensive analysis, excess average returns, the alpha, the Sharpe ratio, and cumulative returns were used as performance measures.

To control the results by the alpha recorded by a fund based on the previous 12 months, each quintile composed based on the R² was subdivided into five quintiles constructed based on the alpha. To facilitate the explanation, these quintiles will be called subquintiles or subportfolios. That is, five subportfolios of funds were constructed in each portfolio, based on the R². The 1st

subportfolio is represented by the funds with the highest alpha values recorded in that quintile based on the R^2 , and so on until the 5th subquintile. By combining quintiles created based on R^2 with subquintiles created based on alpha, the model thus has 25 subportfolios. Each month, reordering and regrouping is carried out of the funds in

the subportfolios following this logic. For performance persistence, it is expected that a fund's historic alpha also has explanatory power for portfolio performance. In other words, the best performance is expected from the subportfolio containing funds with the highest alpha values and the lowest R^2 values.

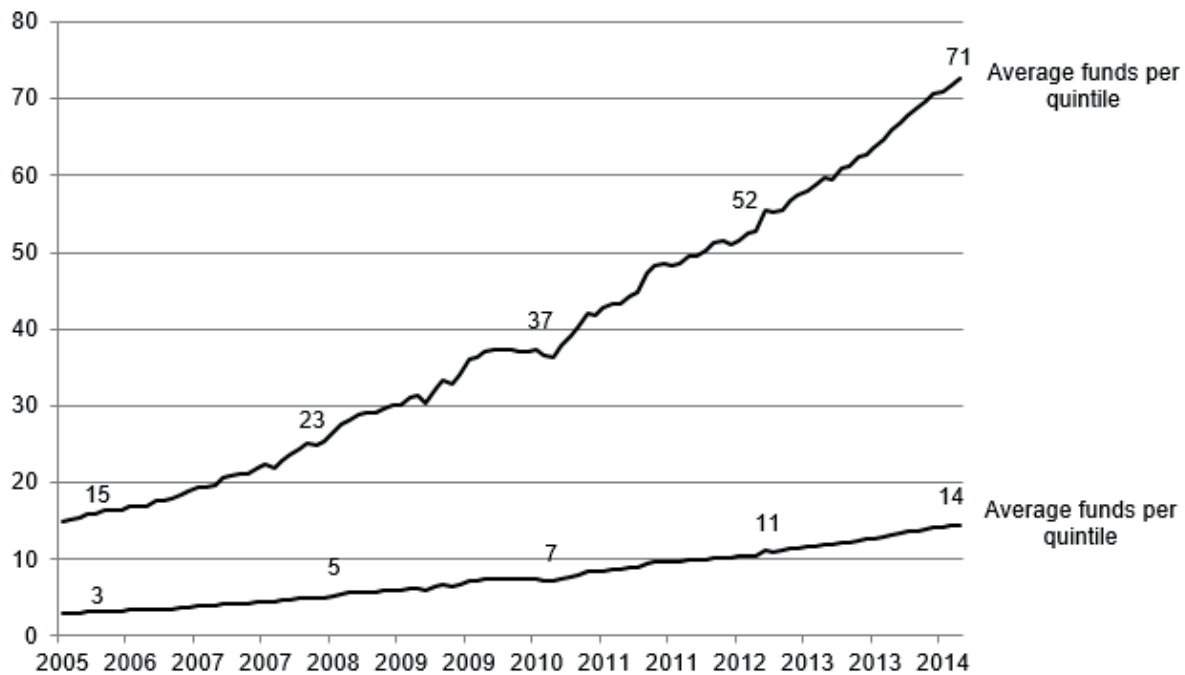


Figure 1 Evolution of the average quantity of funds in each portfolio resulting from the simulation

Note: the quintiles are represented by portfolios of funds selected according to their coefficient of determination (R^2). The subquintiles are subdivisions of the quintiles represented by the portfolios of funds selected according to their alphas. R^2 and alpha are obtained via linear regression for excess fund returns over excess returns on the Bovespa index and using the Interbank Deposit Certificate as a proxy for the risk-free interest rate and 12-month moving windows.

Source: Prepared by the authors.

Finally, portfolios were also constructed with the random selections of funds. Each month, the funds were organized into five quintiles, but chosen randomly instead of ordered by R^2 . The sample used in this simulation is the same and the frequency of selection continues to be monthly, with equal weights. The performance

of these portfolios will be compared with that of those organized according to fund R^2 . The portfolio with the lowest R^2 funds is expected to perform better than those with randomly selected funds. Portfolios with higher R^2 funds are also expected to perform worse than those constituted randomly.

4. RESULTS

The simulations and analyses confirm the hypothesis that there is an inverse relationship between R² and performance in the Brazilian fund market, as verified in the US market by Amihud and Goyenko (2013).

In Tables 2, 3, and 4, the excess average returns, alphas, and Sharpe ratios are presented, respectively, on a monthly basis for each portfolio of funds, representing their performance. The portfolios were generated based on the ordering of the R² and alpha of the sample of funds, with a monthly selection frequency. Each portfolio represents one quintile of the R² distribution and one quintile of the alpha distribution for the funds. A portfolio of funds with the lowest R², for example, is composed of funds that, each month, were among the 20% with the lowest R². The alphas of the portfolios were estimated via regression for all of the sample period, using CDI and Ibovespa as proxies for risk-free interest rate and market returns, respectively. The t statistic of the alphas is also presented in each cell of Table 3.

Table 2 shows that, in the period and sample of funds analyzed, the portfolio of funds with the lowest R² obtained an excess average net return of 0.26% per month and the portfolio of funds with the highest R² obtained an excess average net return of -0.19%. More selective funds presented, therefore, better performance in the excess returns evaluation. The same situation can be found in the evaluation by alphas and by the Sharpe ratio. Table 3 indicates that the portfolio of funds with the lowest R² presented a monthly alpha of 0.34%, and the portfolio of funds with the highest R² presented an alpha of -0.09%. The portfolio of funds with the lowest R² and highest past alpha generated an average alpha (statistically significant to 1%) of 0.87% a month, something close to 11% a year, an even more optimistic result than the 3.8% a year found in the US market by Amihud and Goyenko (2013). In accordance with Table 4, the portfolio with the most selective funds presented a Sharpe ratio of -0.0314. Based on these findings, it is perceived that higher levels of selectivity are rewarded with better performance.

Table 2 Excess average monthly returns for each portfolio of funds.

	Portfolios of funds with the lowest R ² (%)		Intermediate portfolios ^a (%)		Portfolios of funds with the highest R ² (%)		Portfolios without discrimination by R ² (%)
Portfolios of funds with the lowest alpha	-0.46	-0.25	-0.15	-0.44	-0.43		-0.34
Intermediate portfolios ^b	0.14	0.10	0.05	-0.11	-0.39		-0.04
	0.30	0.28	0.32	-0.02	-0.19		0.14
	0.52	0.40	0.32	0.30	-0.08		0.29
Portfolios of funds with the highest alpha	0.79	0.75	0.49	0.41	0.12		0.51
Portfolios without discrimination by alpha	0.26	0.26	0.21	0.03	-0.19		0.11

Note: each portfolio is composed by monthly organizing the sample of Brazilian equity funds considering assets into quintiles (columns), in accordance with their coefficient of determination (R²), and into subquintiles (lines), in accordance with their alpha. The excess returns from the portfolios are also presented without organizing by alpha and without organizing by R². Fund alpha and R² are obtained via regression using the Bovespa index and the Interbank Deposit Certificate and 12-month moving windows.

a: the more to the right this is, the higher the R² of the funds; b: the lower this is, the greater the alpha of the funds.

Source: Prepared by the authors.

The same situation can be observed in the portfolios with the selection also controlled by the alpha of the funds. Out of the portfolios containing funds with the best alpha, the one containing funds with the lowest R² presented, on a monthly basis, an average excess return of 0.79%, an alpha of 0.87%, significance to a degree of 1%, and a Sharpe ratio of 0.1483. As for the least selective funds, or with the highest R², these presented an average

excess return of 0.12%, an alpha of 0.22%, and a Sharpe ratio of 0.0207. By analyzing the intermediate portfolios, it is perceived that the greater the alpha and the lower the R² of the component funds, the lower the performance of the basket of funds. The results show that alpha and R² are relevant parameters for investment choice and for predicting their performance.

Table 3 Monthly alphas for each portfolio of equity funds

	Portfolios of funds with the lowest R ² (%)		Intermediate portfolios ^a (%)		Portfolios of funds with the highest R ² (%)	Portfolios without discrimination by R ² (%)
Portfolios of funds with the lowest alpha	-0.37 (1.17)	-0.15 (0.63)	-0.05 (0.26)	-0.34** (2.21)	-0.32*** (3.27)	-0.24 (1.46)
Intermediate portfolios ^b	0.22 (0.87)	0.20 (0.88)	0.15 (0.77)	-0.01 (0.08)	-0.28*** (3.23)	0.06 (0.36)
	0.39 (1.41)	0.37* (1.74)	0.41** (2.25)	0.08 (0.57)	-0.08 (0.82)	0.23 (1.49)
	0.60** (2.32)	0.49** (2.21)	0.40** (2.29)	0.40** (2.47)	0.02 (0.19)	0.38** (2.37)
	0.87*** (3.14)	0.84*** (3.53)	0.59*** (2.64)	0.51*** (2.95)	0.22 (1.56)	0.61*** (3.24)
Portfolios of funds with the highest alpha	0.87*** (3.14)	0.84*** (3.53)	0.59*** (2.64)	0.51*** (2.95)	0.22 (1.56)	0.61*** (3.24)
Portfolios without discrimination by alpha	0.34 (1.45)	0.35* (1.71)	0.30* (1.78)	0.13 (0.97)	-0.09 (0.90)	0.21 (1.33)

Note: the alphas represent the intercept of the linear regression for excess returns on the portfolios with excess returns on the Bovespa index. The alphas of the portfolios are also presented without organizing by alpha and without organizing by coefficient of determination (R²). The alphas are presented with their respective t statistics, indicating their statistical significance (***: 1%; **: 5%; *: 10%).

a: the more this is to the right, the higher the R² of the funds; b: the lower this is, the higher the alpha of the funds.

Source: Prepared by the authors.

Figure 2 allows for a visual understanding of the performance of some of the portfolios constructed. It presents the evolution of monthly returns for the portfolio containing all of the funds, for that constructed of the funds with the highest R², and that formed of the funds with the lowest R². Moreover, the portfolios constructed by means of random selection are represented by those with the highest and lowest cumulative return in the simulation: 180% and 152%, respectively. The returns are shown in the cumulative composed form based on the same 100 base, in nominal terms. There was no selection

of funds by alpha in the portfolios shown in the figures. The cumulative return for the portfolio of funds with the highest R² was only 70% and very close to that of the Ibovespa (81%), while that of the average for the funds in the sample was 142%. The cumulative return for the most active funds, on the other hand, was 190%, and much higher than that for the portfolio consisting of all of the funds. The results favor the use of the R² as one of the criteria for choosing funds, representing an inverse measure to the idiosyncratic risk to which they are exposed.

Table 4 Monthly Sharpe ratio for each portfolio of funds

	Portfolios with the lowest R ² funds	Intermediate portfolios ^a			Portfolios with the highest R ² funds	Portfolios without discrimination by R ²
Portfolios of funds with the lowest alpha	-0.0753	-0.0398	-0.0244	-0.0722	-0.0673	-0.0573
Intermediate portfolios ^b	0.0262	0.0174	0.0084	-0.0188	-0.0621	-0.0071
	0.0547	0.0514	0.0551	-0.0028	-0.0302	0.0249
	0.1046	0.0729	0.0594	0.0525	-0.0140	0.0541
Portfolios of funds with the highest alpha	0.1483	0.1303	0.0816	0.0699	0.0207	0.0907
Portfolios without discrimination by alpha	0.0494	0.0450	0.0357	0.0048	-0.0314	0.0197

Note: the Sharpe ratio is the ratio of average excess return over risk. Risk is measured by the standard deviation of these excess returns. The portfolios represent quintiles and subquintiles of funds organized monthly by their coefficient of determination (R²) and alpha. The Sharpe ratios of the portfolios without organizing by alpha and without organizing by R² are also presented.

a: the more this is to the right, the higher the R² of the funds; b: the lower this is, the greater the alpha of the funds.

Source: Prepared by the authors.

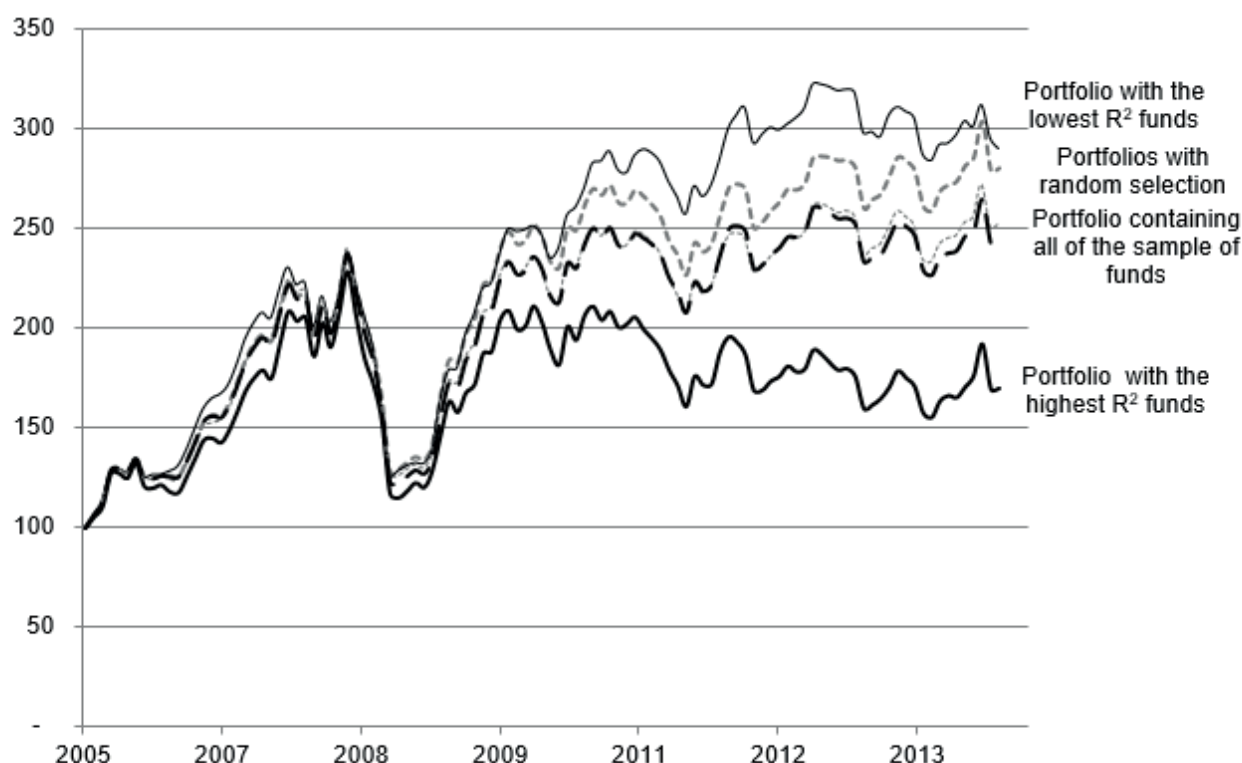


Figure 2 Evolution of cumulative return for the portfolios

Note: the paths of return refer to the portfolios formed of funds with the highest coefficients of determination (R^2), by the lowest R^2 funds, by randomly selected funds (dotted grey line), and by the sample with all of the funds (dotted black line). Out of the randomly composed portfolios, those that showed the highest and lowest final return values were presented, indicating the breadth of results. The values are presented using a base of 100.

Source: Prepared by the authors.

5. ROBUSTNESS TESTS

For initial robustness tests, the same investigation was carried out in two different scenarios: (i) without restrictions in relation to target public, minimum investment, and investor profile, and (ii) ignoring funds with investments abroad. It is also clearly found in these scenarios that the R^2 of the funds is a powerful determinant of performance. Portfolios containing funds with lower R^2 , and consequently with a higher degree of selectivity, present higher performances than those that contain funds

with higher R^2 values. This occurs whether controlling or not for the alpha of the funds. The results are valid both for excess average return and for the Jensen's alpha and the Sharpe ratio. In table 5 and 6 we present the results in these scenarios relative to the Sharpe ratio. The respective tables relative to excess returns and alpha ratios are available from the authors and were not presented in order to save space.

Table 5 Monthly Sharpe ratios for each portfolio of funds in a scenario without filters related to minimum investment and investor profile

	Portfolios with the lowest R ² funds	Intermediate portfolios ^a			Portfolios with the highest R ² funds	Portfolios without discrimination by R ²
Portfolios of funds with the lowest alpha	-0.0631	-0.0280	-0.0458	-0.0337	-0.0812	-0.0517
	0.0005	0.0091	0.0245	-0.0081	-0.0511	-0.0059
Intermediate portfolios ^b	0.0996	0.0720	0.0561	0.0298	-0.0293	0.0429
	0.1385	0.1014	0.0605	0.0483	-0.0033	0.0688
Portfolios of funds with the highest alpha	0.1120	0.0978	0.0900	0.0597	0.0162	0.0762
Portfolios without discrimination by alpha	0.0537	0.0485	0.0361	0.0186	-0.0306	0.0242

Note: the Sharpe ratio is measured by the ratio between the average and standard deviation of excess return on the funds. The Sharpe ratios of the portfolios without organizing by alpha and without organizing by coefficient of determination (R^2) are also presented.

a: the more this is to the right, the higher the R^2 of the funds; b: the lower this is, the greater the alpha of the funds.

Source: Prepared by the authors.

Table 6 Monthly Sharpe ratios for each portfolio eliminating funds that invest abroad

	Portfolios with the lowest R ² funds	Intermediate portfolios ^a			Portfolios with the highest R ² funds	Portfolios without discrimination by R ²
Portfolios of funds with the lowest alpha	-0.0580	-0.0445	-0.0467	-0.0894	-0.0776	-0.0655
	-0.0069	0.0277	0.0067	-0.0292	-0.0650	-0.0143
Intermediate portfolios ^b	0.0505	0.0510	0.0290	-0.0080	-0.0380	0.0166
	0.1157	0.0840	0.0618	0.0148	-0.0186	0.0518
Portfolios of funds with the highest alpha	0.1077	0.1192	0.0886	0.0786	-0.0070	0.0800
Portfolios without discrimination by alpha	0.0409	0.0468	0.0274	-0.0081	-0.0421	0.0124

Note: the portfolios are formed through monthly selection of funds according to their alpha and coefficient of determination (r^2), using the Capital Asset Pricing Method as a pricing model, the Bovespa index and the Interbank Deposit Certificate as market returns and risk-free interest rate and 12-month moving windows. The Sharpe ratio is the ratio between the average and standard deviation for excess returns.

a: the more this is to the right, the higher the R^2 of the funds; b: the lower this is, the greater the alpha of the funds.

Source: Prepared by the authors.

The next robustness test, as previously described, concerns the pricing model used. Instead of using the CAPM, we apply the same methodology, but with the four factors FFC model, as in Amihud and Goyenko (2013). The results were consistent and again in line with all of the previous results for excess returns, Jensen's alpha, and Sharpe ratio. For example, the Jensen's alpha found

in the portfolio of funds with the lowest R^2 and highest past alpha generated an average yearly alpha of 3.7%, compared with -4.6% for the portfolio of funds with the highest R^2 and lowest past alpha. In fact, this value of 3.7% a year is very close to the 3.8% found by Amihud and Goyenko (2013) in the US market. Table 7 presents the results in terms of Sharpe ratio.

Table 7 Monthly based Sharpe ratios for each portfolio of funds using the Fama, French, and Carhart (FFC) model

	Portfolios with lowest R ² funds	Intermediate portfolios ^a			Portfolios with highest R ² funds	Portfolios without discrimination by R ²
Portfolios of funds with the lowest alpha	-0.0216	-0.0134	-0.0245	-0.0525	-0.0686	-0.0375
Intermediate portfolios ^b	-0.0028	0.0199	0.0351	0.0063	-0.0325	0.0051
	0.0240	0.0523	0.0370	0.0214	-0.0117	0.0248
	0.1061	0.0545	0.0537	0.0417	0.0131	0.0537
Portfolios of funds with the highest alpha	0.1039	0.0811	0.0712	0.0652	0.0371	0.0727
Portfolios without discrimination by alpha	0.0417	0.0388	0.0345	0.0156	-0.0135	0.0230

Note: coefficient of determination (R^2) and alphas of the funds result from the linear regression using the Bovespa index and the additional risk factors “small minus big”, “high minus low”, and “winners minus losers” of the FFC model.

a: the more this is to the right, the higher the R^2 of the funds; b: the lower this is, the greater the alpha of the funds.

Source: Prepared by the authors.

6. DETERMINANTS OF THE FUNDS' R^2

As the R^2 is an abstract measure, it is important to understand which characteristics of Brazilian equity funds can indicate high and low levels of selectivity (according to the R^2). For this, as Amihud and Goyenko (2013) elaborated in the US market, regressions were carried

out with panel data using a logarithmic transformation of this measure (which we will call TR^2) as the dependent variable. The TR^2 has a symmetrical distribution, works better than the R^2 , and is calculated in accordance with equation 3.

$$TR^2 = \log [(\sqrt{R^2} + c) / (1 - \sqrt{R^2} + c)]$$

3

in which $c = 0.5/n$ and $n = 12$, this being the size of the sample used to construct the R^2 series.

The fund attributes used as explanatory variables in the model were size, in the logarithmic form and quadratic logarithm (to analyze curvature), expenses (measured by administration fees over net equity), style, and age (in logarithmic form). The styles were represented by dummies identifying funds (i) focused on shares that distribute dividends, (ii) focused on small caps, and (iii) referenced to indices. Funds that do not fit into these three styles have less common actions or do not present any commitment to a specific strategy. Age corresponds to the time in years since the fund began operations. Size is measured by fund net equity. Information related

to changes in management and fund turnover, despite being used in the US study, did not present any levels of availability, coverage, and sufficient quality in the databases used and so they were not used.

Eight 12-month windows were removed from the sample without any overlap with the funds' TR^2 at the end of the window and their attributes at the beginning. The regressions were carried out with errors clustered by fund and units of time, as well as containing dummies for each 12-month period. The results from the regressions can be observed in Table 8, in which we present them both for the CAPM model and for the FFC model (as a robustness test).

Table 8 Calculation of the coefficient of determination (R^2) based on the funds' attributes as independent variables - TR given by equation 3

Independent variables, lagged	CAPM	FFC	Style dummies	CAPM	FFC
Log(Size)	68.80*** (3.09)	48.97*** (2.96)	Dividends	1.21 (0.37)	8.79*** (4.71)
[Log(Size)] ²	-4.60*** (3.06)	-3.29*** (2.96)	Small caps	-18.51*** (5.59)	-4.03 (1.54)
Expenses	47.31 (0.47)	-16.84 (0.22)	Active index	20.79*** (10.53)	11.94*** (7.81)
Log(Age)	19.28*** (6.42)	13.07*** (5.81)	R^2	28%	27%

Note: the coefficients and their respective *t* statistics result from the panel regressions for the transformed logarithm of the R^2 of Brazilian equity funds in function of their main statistical and dynamic attributes. The R^2 of the excess return for the funds is obtained based on the Capital Asset Pricing Method (CAPM) and Fama, French, and Carhart (FFC) pricing models.

***: statistical significance to 1%.

Source: Prepared by the authors.

Independent of the pricing model used, R^2 is rising and concave for the size variable, which is shown by the positive coefficient in the first degree and negative coefficient in the second (both statistically significant), exactly like the US market. On the other hand, the administrative expenses variable was not statistically significant. Age was very significant in both pricing models, as well as positive, which is another result that differed from Amihud and Goyenko (2013): new funds

tend to be more selective in Brazil.

With regards to the styles analyzed, the fact a fund is referenced indicates less selectivity, which is consistent with what is expected for an index-based fund. Funds that bet on shares with dividends present a bias for a high R^2 , indicating less selectivity, and funds that invest in shares in relatively small companies have a bias for a lower R^2 (negative coefficient).

7. CONCLUSION

This paper applied, in the Brazilian equity funds market, the methodology from Amihud and Goyenko (2013) for predicting performance based on level of activity, as measured by the R^2 , that is, the R^2 of the regression for excess fund returns in relation with excess market returns (measured by the Ibovespa). We investigated a sample of 867 equity funds considered active over the period from November 2004 and October 2014.

As in the US market, this methodology was quite effective in Brazil for constructing portfolios of better performing funds. Funds with lower R^2 values, identified as being more selective, presented above average returns and funds with higher R^2 values, or that accompanied market performance more, had a below average performance in the period analyzed. The portfolio of funds that recorded the highest level of activity presented an average excess return of 0.26% a month, a monthly alpha of 0.34%, and a Sharpe ratio of 0.0494. The portfolio composed of the least selective funds presented an average excess return of -0.19%, an alpha of -0.09%, and a Sharpe ratio of -0.0314. With regards to cumulative return, the portfolio with the most selective funds presented a performance of 190%,

while the portfolio with the least selective funds, or with the lowest R^2 , obtained only 70%.

This study confirms the hypothesis that funds' exposure to idiosyncratic risk results in better performance, even when measured by the Sharpe ratio (which adjusts exposures to different levels of risk). The results found are robust when we use the four factors FFC model instead of the traditional CAPM. The conclusion that selectivity leads to higher returns corroborates with previous studies carried out in the Brazilian (Malacrida et al., 2007; Rochman and Eid, 2006) and international (Cremers and Petajisto, 2009; Daniel et al., 1997; Kacperczyk et al., 2005) markets. Performance was measured by excess average return, by the Jensen's alpha, by the Sharpe ratio, and by cumulative returns. In all cases, the performance of the constructed portfolios increases gradually with a reduction in the R^2 of the component funds. An additional, but equally interesting result is that the historic alpha of the component funds also determined performance. In other words, past performance (measured by the Jensen's alpha) indicates a higher chance of future performance. The alpha and the R^2 of the funds were, therefore, (at least

reasonable) indicators of performance and can thus be used by investors to decide which assets (more precisely, Brazilian equity funds) their resources will be allocated to (this conclusion is especially relevant for funds of funds).

As a suggestion for future research, it could be investigated whether a portfolio with a low and fixed

number of low R² and high Jensen's alpha funds would maintain the efficient performance found here, in order to make it possible to build a portfolio with fewer funds and probably lower costs. Another promising idea would be to try and identify the sources of risk not captured by the CAPM that would explain the performance of these fund.

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