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Anomalies and Investor Sentiment: Empirical Evidences in the Brazilian Market

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Abstract

This study examined the relationship between investor sentiment and value anomalies in Brazil. In addition, it analyzed if pricing deviations caused by investors with optimistic views are different from those caused by pessimistic investors. The sample included all non-financial firms listed on the B3 (*Brasil, Bolsa, Balcão*) stock exchange from July 1999 to June 2014. We used the Principal Component Analysis multivariate technique to capture the component common to four different proxies for investor sentiment. The study empirically tested the index series and its variation on the return series of Long-Short portfolios of 12 anomaly-based strategies. The study found that the measure of the sentiment index had a partial explanatory power for the anomalies only when included in the CAPM. Yet, when using the index sentiment changes as an explanatory variable, the study found a relationship with future returns, robust to all risk factors. Thus, it is possible to relate investor sentiment index to anomaly-based portfolio returns. When analyzing average returns after optimistic and pessimistic periods, the values we found in our empirical test were not statistically significant enough to infer the possible existence of short-sale constraints.

Key words: investor sentiment index; value anomalies; long-short strategies.

Introduction

International literature has been extensively investigating the impact of investor sentiment on financial markets. To measure sentiment, Baker and Wurgler (2006) constructed an index based on proxies for investor behavior and demonstrated that this measure can significantly predict future returns, especially for the riskiest and hardest-to-arbitrage stocks. Since then, this index has been widely used in empirical research as an aggregate measure for investor sentiment in the US market. In this sense, evidences have been found that establish a strong relation between sentiment index and market anomalies (Antoniou, Doukas, & Subrahmanyam, 2010; Stambaugh, Yu, & Yuan, 2012). The theoretical justification is that some anomalies may reflect, at least in part, mispricing deriving from unsophisticated investors' behavior.

The premise that investor sentiment has a significant impact on determining stock values has been used in a number of studies that analyze the relationship between returns and an investor sentiment index, producing evidence that sentiment does have an influence on stock prices (Baker & Wurgler, 2006, 2007; Baker, Wurgler, & Yuan, 2012; Barberis, Shleifer, & Vishny, 1998; Brown & Cliff, 2004; Delong, Shleifer, Summers, & Waldmann, 1990; Shiller, 2000; Stambaugh *et al.*, 2012; Yu, 2013; Yu & Yuan, 2011).

Most studies in this area have been conducted in the US market; in Brazil – a market where mispricing may derive from investor behavior –, research is still scarce. Martins, Pereira, Amorim, Oliveira and Oliveira (2010) studied the relation between investor sentiment and firm book-to-market ratios and did not find a significant relation. Yoshinaga and Castro (2012) found a negative and significant relation between the sentiment index and future returns in the Brazilian market. Such evidence – that the investor sentiment index is an important component of asset pricing in Brazil – make way for new questions related to the intensity and way investor sentiment influences returns. In addition, studies that involve the investor sentiment index are recent and no study on market anomalies in Brazil was found in the literature that addresses this aspect.

There is a growing amount of evidence that indicate the existence of market anomalies in Brazil (Leite, Pinto, & Klotzle, 2016; Machado & Medeiros, 2014; Rogers & Securato, 2009; Santos, Famá, & Mussa, 2012; Silva & Machado, 2016); however, studies that address the behavioral approach of these anomalies are still incipient. This scenario aroused our interest to study how investor sentiment relates to stock market anomalies in Brazil. The theoretical model was based on the works of Baker and Wurgler (2006, 2007) for the construction of the index, and the work of Stambaugh, Yu and Yuan (2012) to empirically test the relation between sentiment and anomaly.

All considered, this paper aims to analyze the relation between the investor sentiment index and stock market anomalies in Brazil. To that end, the researchers set out to construct an aggregate investor sentiment index for the Brazilian market, on proxies used by Baker and Wurgler (2006, 2007); examine the relation between the investor sentiment index and the returns of portfolios formed on Long-Short strategies based on value anomalies; analyze the performance of portfolios formed on Long-Short strategies based on value anomalies, comparing periods of high and low investor sentiment; and compare the performance of long positions and short positions for portfolios formed on Long-Short anomaly-based strategies.

Therefore, this research contributes to the literature, mainly in that it analyzes the Brazilian market and the relation between value anomalies and investor sentiment. Another of this study's contributions is to evaluate how pricing deviations caused by optimistic investors are different from those caused by pessimistic investors.

Literature Review and Hypotheses

Fama and French (2008) indicate some return patterns that are not explained by the CAPM, known as market anomalies. Among the major anomalies, studies have found abnormal excess returns of low capitalization stocks (Banz, 1981), high book-to-market stocks (Fama & French, 1992; Rosenberg, Reid, & Lanstein, 1985), and highly profitable stocks (Cohen, Gompers, & Vuolteenaho, 2002; Haugen & Baker, 1996). Jegadeesh and Titman (1993) demonstrated that stocks that produced low return in the previous year tend to achieve low returns in the following months, whereas stocks that produced high returns in the previous months tend to accomplish high returns in the following months. Other studies show an inverse relation between past and following returns (Daniel, Hirshleifer, & Subrahmanyam, 1998; Hong & Stein, 1999). Still, there is evidence of a negative relation between return rate and investment (Fairfield, Whisenant, & Yohn, 2003; Titman, Wei, & Xie, 2004); high accruals and following returns (Sloan, 1996), and; equity issuance and return rate (Daniel & Titman, 2006; Pontiff & Woodgate, 2008).

To Barberis and Thaler (2002), anomalies in documented pricing models cannot be easily explained from the traditional rational perspective and, in this aspect, behavioral economics argues that asset price deviations from fundamental values are caused by investors that are not totally rational (Barberis *et al.*, 1998; Barberis & Thaler, 2002; Delong *et al.*, 1990; Shiller, 2000, 2003). In this context, a number of studies have found empirical evidence that investor sentiment can possibly contain a vast market component capable of driving the prices of several assets at once towards a specific direction (Baker & Wurgler, 2006, 2007; Baker *et al.*, 2012; Brown & Cliff, 2004; Stambaugh *et al.*, 2012; Yu & Yuan, 2011).

The growing literature consolidates a consensus that investor sentiment affects stock prices, thus driving researchers to a new issue, that of seeking the best ways to measure sentiment (Baker & Wurgler, 2007). The simplest, most intuitive and straightforward way is a survey with investors, as in the University of Michigan index and the research conducted by Prof. Robert Shiller at Yale University. In Brazil, the closest there is to this approach is the Consumer Confidence Index (*Índice de Confiança do Consumidor* [ICC]) of the São Paulo State Trade Federation (*Federação do Comércio do Estado de São Paulo*).

Economists view sentiment measures obtained through surveys with some suspicion, since there is a potential distance between what respondents say and their behavior (Baker & Wurgler, 2007). Another approach uses secondary data of investor transactions as proxies for sentiment. Lee, Shleifer and Thaler (1991) used the closed end-fund discounts (CEFD) as a sentiment measure, as this represents the distortion between the prices considered by investors and fundamental prices. Among the most cited works on sentiment index is that of Baker and Wurgler (2006), who developed a sentiment index constructed on the first principal component of six proxies related to investor behavior. In the Brazilian market, Yoshinaga and Castro (2012) have found evidence that the investor sentiment index is an important component in asset pricing.

Despite the influence of the sentiment index on stock prices, Stambaugh *et al.* (2012) found evidence that sentiment-related mispricing is asymmetrical, that is, overpricing is greater and more frequent than underpricing. Overpricing in the stock market may occur because of optimistic investors, who act by increasing buy orders, or – when they already own the stocks – by taking no position, thus making sell orders smaller than buy orders. In turn, underpricing has less influence, since pessimistic investors may short sell or, when they already own the stocks, sell them the conventional way. Stambaugh *et al.* (2012) associated their results with the Miller's argument (1977), which defends that short-sale constraints, such as additional risk, limit this type of operation and, thus, underpricing could be caused only by the increase in conventional sales of pessimistic investors who would be willing to close their long positions, which they normally are not willing to do. This way, distortions in prices caused by optimistic investors are greater than those caused by pessimistic investors.

Finally, in Brazil, there is evidence that short-sale constraints affect prices, thus causing overpricing. Chague, De-Losso, De Genaro and Giovannetti (2014) studied the effect of demand (short-sellers are informed) and supply (short-sellers are restricted) in the stock lending market on share prices and concluded that short sellers are well-informed, thus increasing the demand for equity lending. However, the low supply in the equity lending market prevent prices from reflecting all information available in the market. Corroborating the Miller's hypothesis (1977), there is evidence in the Brazilian market that the high levels of equity lending create constraints that affect stock prices (Bonomo, De Mello, & Mota, 2015; Chague, De-Losso, De Genaro, & Giovannetti, 2014, 2017).

Considering that market anomalies may be comprised of both risk premium components and components related to mispricing caused by irrational expectations, sentiment index may have an important role in explaining part of mispricing, which – to a certain extent –are related to market anomalies. Therefore, based on recent empirical evidence (Stambaugh *et al.*, 2012), this study sets the following research hypothesis:

$\boldsymbol{H_1}$**:** In the Brazilian stock market, it is possible to relate investor sentiment to portfolio returns, according to Long-Short anomaly-based strategies.

Given the evidences that price distortions due to pessimistic investors are smaller than those caused by optimistic investors (Miller, 1977; Stambaugh *et al.*, 2012), this study also intends to test the following hypotheses:

$\boldsymbol{H_2}$**:** Value anomalies in the Brazilian stock market are greater after periods of optimism than after periods of pessimism.

$\boldsymbol{H_3}$**:** In Long-Short anomaly-based strategies, short positions perform better than long ones.

Methodological Procedures

Sample and data

The analysis was conducted considering the period from 1999 to 2014, using a sample that included, year after year, all stocks of non-financial firms listed at B3 (*Brasil, Bolsa, Balcão*), which had monthly quotations for 24 consecutive months, negotiability over 0.01 and positive equity. Thus, the average number of stocks analyzed per year was 214, a minimum number of 174, from July 1999 to June 2000, and a maximum number of 260, from July 2011 to June 2012. This time interval was chosen due to the limited data on equity issuance made available by the Securities and Exchange Commission (CVM, acronym in Portuguese). Data were collected to calculate a sentiment index and form portfolios on a monthly basis, which was the frequency chosen to obtain time series sufficiently large to analyze portfolios created on anomalies and, at the same time, be able to capture proxies for investment sentiment. The data used in this study were collected from Economatica and all methodological procedures were run on R statistical software.

Constructing the investor sentiment index

In this phase, we used a set of proxies that were already used in previous works, such as Brown and Cliff (2004), Baker and Wurgler (2006, 2007), and Yoshinaga and Castro (2012), applied to the US and Brazilian market, respectively. The proxies selected to make up the index are: number of initial public offers ($NIPO_t$), percentage of new equity issues (NEI_t), stock turnover ($TURN_t$) and advancing issues to declining issues ratio (AD_t). Proxies were chosen based on the available information in Brazil to calculate the variable on a monthly basis. For example, in this study it was not possible to include the dividend premium proxy — obtained on the market-to-book index relation of firms paying dividends

and firms not paying dividends — since the accounting data necessary to calculate the said index are available, at a minimum, on a quarterly basis.

The $NIPO_t$ variable was obtained by the total number of initial public offers (IPO) in the month. In turn, IPO returns ($RIPO_t$) was obtained by the average variation between first-day closing and opening prices. Unlike the aforementioned variables, the percentage of new equity issues (NEI_t) considers the equity issues of both initial offers and subsequent offers, and was obtained by the relation between the financial volume of the total equities issued and that of the total equities and debts issued to raise funds (stocks, debentures and promissory notes). Stock turnover ($TURN_t$) was calculated by dividing the quantity of stocks negotiated in the month by the total of stocks circulating at the end of the month. The number of advancing issues to declining issues ratio (AD_t) was the monthly ratio of the volume of low stocks negotiated and the volume of high stocks negotiated, which are given by the relation between the quantity negotiated of each stock group. Therefore, every month stocks were sorted into two groups, high stocks (positive last-month return) and low stocks (negative last-month return). Next, we calculated the volume of negotiations of high stocks and the volume of negotiations of low stocks; last, we divided one by the other.

Baker and Wurgler (2006) indicate that each proxy is likely to carry idiosyncratic components unrelated to sentiment; it is then important to obtain the common component that represents investor sentiment. To this end, the Principal Component Analysis (PCA) multivariate technique was used to isolate the common component in these proxies, thus obtaining a better representation of investor sentiment. According to Baker and Wurgler (2006), the index was estimated in three steps: the first step aimed to identify if any of the proxies reflect the sentiment sometime after the others; the second step used only those identified as the best variables; the last step had the objective of preventing the index from reflecting business cycle information. The selected proxies were regressed on macroeconomic variables and the residuals were submitted to PCA.

The first step aims to obtain the common component related to the variable lags, since some proxies may reflect investor sentiment after the others (Baker & Wurgler, 2006). Therefore, to identify the moment each variable reflects investor sentiment, PCA was used including not only the proxies (NEI_t, $NIPO_t$, $TURN_t$ e AD_t) but also their lags (NEI_{t-1}, $NIPO_{t-1}$, $TURN_{t-1}$ and AD_{t-1}). Next, the correlation with the first component was used as the criterion to choose between the variable or its lag.

The second step used PCA that considered only the proxy itself or its lag, depending on which one provided a higher correlation with the first component estimated in the first step. At this PCA, the first component was considered a partial sentiment index.

To extract business cycle effects possibly captured by the index, in the third step, the selected proxies were regressed on macroeconomic variables, such as GDP increase and inflation; then, PCA was run using the residuals, forming a final index based on the first component. All Principal Components Analyses were estimated by using the correlation matrix to prevent problems of scale differences between variables.

Formation of portfolios on long-short strategy

To relate investor sentiment to abnormal returns, portfolios were constructed on the following anomalies previously documented in Brazil: size, value, momentum, volatility, liquidity, earnings-to-pricing ratio, EBITDA/total asset, leverage, growth sales, ROA, asset growth and investment (Leite *et al.*, 2016; Machado & Medeiros, 2011, 2014; Rogers & Securato, 2009; Santos *et al.*, 2012; Silva & Machado, 2016). For each of the studied anomalies, Long-Short portfolios were formed on the extreme quintiles, 1 and 5, where long position is the high-performance quintile, depending on the behavior of the anomaly in the Brazilian market. As in Stambaugh *et al.* (2012), a portfolio was formed to equally combine all mentioned strategies; therefore, its monthly return was obtained through the arithmetic mean of all other portfolios. When the Long and Short portfolios were formed, the excess returns of each portfolio were analyzed, and the returns of each strategy were adjusted to risk, by using Fama and

French's three-factor pricing model (1993) and Carhart's four-factor model (1997). The excess return was calculated as the portfolio return minus the risk-free rate, which, in this study, is given by SELIC.

Description of the econometric model

The model used in this study was based on the work of Stambaugh *et al.* (2012), which initially verifies the influence of the investor sentiment index on the returns for each strategy. For this, the returns of the portfolios formed on the extreme quintiles of each anomaly values ($R_{i,t}$) are regressed as a dependent variable on the investor sentiment index of the previous month ($bSent_{t-1}$). (Equation 1).

$$R_{i,t} = a + bSent_{t-1} + \varepsilon_t \quad (1)$$

Stambaugh *et al.* (2012) demonstrated that the regression of the returns on the investor sentiment index alone may signal the behavior of the strategies in relation to the index; however, it is important to verify the relationship between strategy returns and the sentiment index when controlled by Fama and French's three-factor model (1993) and Carhart's four-factor model (1997).

To separately examine how the periods of optimism (high-sentiment index) and the periods of pessimism (low-sentiment index) influence each strategy, two dummies were created: one concerning the periods in which the investor sentiment index in the previous period is over the median, and the other concerning the periods in which the index of the previous period is below the median. This way, it was possible to calculate the average returns for each period and consequently test if the null hypothesis that the average return after periods of optimism is below zero can be rejected. For the average returns after the pessimistic periods or within the spread between optimism and pessimism, the null hypothesis to be rejected is that the values are over zero.

To analyze the differences of returns after periods in which the investor sentiment index in the previous period is high or low, the return as a dependent variable was regressed on the dummies, on high and low sentiment, and on the market, size and book-to-market factors (Equation 2).

$$R_{i,t} = a_H d_{H,t} + a_L d_{L,t} + bMKT_t + cSMB_t + dHML_t + \varepsilon_{i,t} \quad (2)$$

Where: $R_{i,t}$ = return in month *t* at Long, Short extremes and Long minus Short; a_H = estimator of returns on the high orthogonalized investor sentiment index; $d_{H,t}$ = dummy indicating periods of high investor sentiment index; a_L = estimator of returns on the low orthogonalized investor sentiment index; $d_{H,t}$ = dummy indicating periods of low investor sentiment index; ε_t = random error term.

Given the proposed models and established hypotheses, we expect to obtain a positive relation between the sentiment index and the long position, and a negative relation between the index and the short position. However, we do not expect that the relation will be significant for the long positions in all cases, whereas, for the short positions, only after periods in which the sentiment index is below the median, as captured by the models of Equation 2.

All regressions use the estimator of ordinary least squares (OLS) with errors robust to the correlation and heteroskedasticity, by means of the Newey and West (1987) robust matrix. It is important to note that we ran Variance Inflation Factors (VIF) tests and they found no multicollinearity among the regressors.

Result Analysis

Descriptive statistics

Table 1 shows the descriptive statistics of the proxies for investor sentiment. The averages of the NIPO, NEI and TURN variables are lower than those used by Yoshinaga and Castro (2012), whose values were 4.02, 0.32 and 0.18, respectively. Note that a lower average is expected in the case of the NIPO variable, since this work is considering a monthly frequency.

Table 1

Descriptive Statistics of the Proxies for Investor Sentiment

	Mean	Minimum	1st qt.[f]	SD[e]	Median	3rd qt.	Maximum
NIPO[a]	0.8280	0.0000	0.0000	1.6546	0.0000	1.0000	13.0000
NEI[b]	-0.0041	-0.3500	-0.1136	0.1593	-0.0046	0.1152	0.3693
TURN[c]	0.0426	-0.5292	-0.1330	0.2246	0.0241	0.1904	1.0594
AD[d]	-0.1466	-2.0949	-0.7497	0.8791	-0.1237	0.4318	3.3322

Note. [a] Number of initial public offers, [b] percentage of new equities issued, [c] stock turnover, [d] number of advancing issues to declining issues ratio, [e] standard deviation and [f] quartile.

The average first-day return of IPOs (RIPO) was withdrawn from the analysis for it provided insufficient data quantity for the calculation, since the absence of IPOs in some months does not allow the average return to be calculated for these periods and, consequently, the variable cannot be included in the analysis of the principal components due to missing values. For the NIPO variable, the months when there were no initial public offers were considered as zero rather than missing values, for we consider that months with no IPOs (that is, zero) provide important information for this study as they signal that at this specific moment corporate managers were not optimistic about the market and, therefore, none of them chose to offer stocks.

The TURN variable had a growth tendency over the analyzed period, just like in the USA, Canada, France, Japan and the UK (Baker *et al.*, 2012). This tendency may not reflect investor sentiment, but rather a decrease in transaction costs that took place over the years (Baker & Wurgler, 2006). To detrend the TURN, this work applied the same procedure used in international works (Baker *et al.*, 2012; Baker & Wurgler, 2006, 2007), that is, turnover was considered the difference between the current value and the moving average of the previous three years. This procedure causes the TURN variable to represent the turnover variation on the average of the previous three years; thus, it may be a negative value. Although it represents the variation, seeking simplification, this work shall go on referring to this variable as turnover.

Table 2 shows statistics of the following factors: market risk premium (MKT), size (SMB), book-to-market (HML) and momentum (UMD). The market premium found was 0.463%; although it is not statistically significant, it is well below that of Machado and Medeiros (2011) and Silva and Machado (2016), which found 3.09% and 2.3%, respectively. A possible explanation for this difference is the impact of the crisis in addition to the reduced sample when compared to the other studies, whose samples go back to the year 1995 (Machado & Medeiros, 2011; Silva & Machado, 2016), whereas this study considered only the period between 1999 and 2014.

Table 2

Descriptive Statistics of Risk Factors

	Mean	Minimum	1st qt. [f]	SD [e]	Median	3rd qt.	Maximum
MKT[a]	0.00463	-0.264953	-0.02749	0.05952	0.007524	0.04496	0.15032
SMB[b]	0.00621 *	-0.107761	-0.02227	0.04234	0.002526	0.03309	0.11267
HML[c]	-0.00430	-0.187921	-0.02856	0.04676	-0.005214	0.02992	0.10626
UMD[d]	-0.00798 **	-0.183473	-0.03482	0.04730	-0.005223	0.02347	0.11527

Note. [a] Market risk premium calculated on market portfolio return minus the risk-free rate (SELIC), [b] size premium given by the small-firm portfolio return minus the big-firm portfolio return, [c] high book-to-market return minus low book-to-market return and [d] return of stocks that faced a high in the last eleven months minus stocks that faced a low. [e] SD – Standard Deviation, [f] qt. – quartile.
Level of significance: * 10% ** 5% ***1%.

The size factor was 0.621%, significant at the 10% level, contradicting the findings of Machado and Medeiros (2011) and corroborating the findings of Santos, Famá and Mussa (2012). The momentum factor provided a negative prize of -0.798%, significant at the 5% level, corroborating Santos *et al.* (2012) and contradicting the findings of Machado and Medeiros (2011). These results imply that, for the sample and period studied, the model used was capable of capturing risk factors on size and momentum, producing evidences that these risk factors may be being priced.

Return of the long-short portfolios (dependent variables)

The monthly returns of the Long-Short portfolios were obtained from the difference between the monthly return of each one of them and the risk-free asset return. Table 3 presents the descriptive statistics of the portfolios. Standard deviation is around 0.04 for the equally-weighted portfolios whereas it is slightly higher for market-value weighted portfolios.

Table 3

Returns of the Long-Short Portfolios

	Value-weighted			Equally-weighted		
	Average [e]	p-value	σ	Average [e]	p-value	σ
Size	0.039	0.002	0.162	0.004	0.355	0.063
B/M ratio	0.002	0.709	0.081	0.011	0.002	0.046
Momentum [a]	0.004	0.479	0.072	0.008	0.037	0.047
Volatility	0.018	0.000	0.062	0.016	0.000	0.050
Liquidity [b]	0.012	0.061	0.081	0.011	0.033	0.069
Earnings-to-pricing	0.015	0.002	0.063	0.019	0.000	0.047
EBITDA/AT	0.000	0.934	0.055	0.013	0.001	0.047
Leverage	0.009	0.010	0.044	0.003	0.214	0.036
Growth Sales	0.003	0.579	0.063	0.007	0.038	0.042

Continues

Table 3 (continued)

	Value-weighted			Equally-weighted		
	Average [e]	**p-value**	**σ**	**Average [e]**	**p-value**	**σ**
ROA	0.015	0.006	0.070	0.014	0.001	0.055
Asset Growth[c]	0.003	0.518	0.065	0.001	0.726	0.049
Investment [d]	0.001	0.785	0.063	0.003	0.432	0.047
	0.010	0.000	0.030	0.009	0.000	0.020

Note. All portfolios were rebalanced in June of each year, based on market data of June and accounting data of December.[a] Portfolios rebalanced on momentum, determined by the accumulated stock return in the previous 11 months, [b] portfolios rebalanced on the average volume negotiated in Brazilian reais (R$) in the last 12 months, [c] asset growth is set by the total asset growth rate (AT_{t-1}/AT_{t-2}), [d] portfolios rebalanced on the investment variable, which was measured by the annual change in fixed asset plus the annual change in inventory, divided by the total asset value in the previous year. [e] For each of the studied anomalies, Long-Short portfolios were formed on the extreme quintiles, 1 and 5, where Long was the high-performance quintile, depending on the behavior of the anomaly in the Brazilian market.

Note the 0.16 standard deviation of the portfolio formed on firm size, which was very high in relation to the other portfolios. The general analysis of the standard deviations found that no strategy was superior to the others, except for spread in the portfolios formed on size, which possibly imply higher risk.

Table 4

Correlation between Variables and the First Principal Variable

Value-weighted	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
(1) Size	1.0											
(2) B/M ratio	-.23	1.0										
(3) Momentum [a]	.01	.49	1.0									
(4) Volatility	.28	-.13	.10	1.0								
(5) Liquidity [b]	.17	-.04	.09	.22	1.0							
(6) Earnings-to-pricing	.06	.19	.37	.05	.02	1.0						
(7) EBITDA/AT	-.21	.33	.29	-.09	-.05	.36	1.0					
(8) Leverage	-.07	.35	.22	.02	.03	.13	.10	1.0				
(9) Growth Sales	-.10	.28	.33	.10	-.05	.37	.30	.05	1.0			
(10) ROA	-.04	.31	.46	-.06	-.12	.66	.51	.10	.42	1.0		
(11) Asset Growth [c]	.15	-.43	-.20	.17	.19	-.07	.08	-.17	-.31	-.04	1.0	
(12) Investment [d]	.13	-.32	-.17	.08	.11	-.11	.15	-.22	-.16	-.09	.72	1.0
(13) Combined	.48	.32	.59	.39	.35	.59	.43	.26	.40	.57	.17	.13

Continues

Table 4 (continued)

Equally-weighted	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) Size	1.0											
(2) B/M ratio	.49	1.0										
(3) Momentum [a]	-.32	.27	1.0									
(4) Volatility	.76	.42	-.12	1.0								
(5) Liquidity [b]	.60	.43	-.16	.45	1.0							
(6) Earnings-to-pricing	-.18	.14	.49	-.01	.00	1.0						
(7) EBITDA/AT	-.68	-.35	.48	-.49	-.32	.39	1.0					
(8) Leverage	-.21	-.14	.22	-.08	-.21	.16	.10	1.0				
(9) Growth Sales	-.34	-.33	.26	-.21	-.20	.13	.37	.07	1.0			
(10) ROA	-.60	-.16	.58	-.40	-.26	.66	.73	.37	0.23	1.0		
(11) Asset Growth [c]	.46	.47	-.20	.42	.41	.09	-.22	-.24	-.33	-.29	1.0	
(12) Investment [d]	.37	.37	-.13	.36	.33	.05	-.07	-.18	-.24	-.23	.77	1.0
(13) Combined	.40	.50	.33	.53	.56	.59	.12	.10	.02	.27	.56	.55

Note. [a] Portfolios rebalanced on momentum, determined by the accumulated stock return in the previous 11 months, [b] portfolios rebalanced on the average volume negotiated in Brazilian reais (R$) in the last 12 months, [c] asset growth is set by the total asset growth rate, [d] portfolios rebalanced on the investment variable, which was measured by the annual change in fixed assets plus the annual change in inventory, divided by the total asset value of the previous year.

As expected, most of the portfolios provided a low correlation among their returns, except for the 0.72 correlation between the Investment strategy and Asset Growth (Table 4). This happens because some of the chosen variables – although they are calculated in a different way – represent the same characteristic. The analysis of similar strategies turns out to be useful, for it allows understanding what the difference is between these variables in the portfolio performance.

Investor sentiment index

The use of Principal Components Analysis (PCA) to estimate the index followed the steps taken by Baker and Wurgler (2006). The first step comprised running a PCA with all variables and their lags to identify the moment when each variable reflects investor sentiment; the selection criterion was the correlation with the first component. Baker and Wurgler (2006, 2007) used 12-month lags, whereas Yoshinaga and Castro (2012) used 3-month lagged variables. To determine the ideal period of lags, tests were run with different lag periods. The selection criterion was the percentage of variance explained by the first component and the eigenvalue of the first component.

The best-fitting lag period was 11 months, which provided a higher ratio of variance explanation (39.50%). This ratio is found in the average values provided by Baker, Wurgler and Yuan (2012), who used indices with variance explanation of 38%, 40%, 49%, 37%, 37% and 42%, for Canada, France, Germany, Japan, the UK and the USA, respectively. Yoshinaga and Castro (2012) used an index where 49% of the variance was explained by the first component. Such difference may be due to a difference in the proxies used or to the influence of the common idiosyncratic variation in higher frequencies.

To choose between each variable or its lag, the correlation with the first component was spotted at the PCA conducted in the first step. Table 5 shows these correlations. Only the variable AD_{t-1} provided no correlation with the principal component; however, AD_t provided a correlation of -0.23, significant at the 1% level. Brown and Cliff (2004) found the same relation for a weekly frequency and an inverse relation for the monthly frequency. The equity issuance and turnover provided similar correlation to their lags; the IPO number, however, was far higher in its lagged form.

Table 5

Correlation between Variables and the First Principal Component

	$NIPO_t$	$NIPO_{t-1}$	NEI_t	NEI_{t-1}	$TURN_t$	$TURN_{t-1}$	AD_t	AD_{t-1}
Correlation	0.3041***	0.6915***	0.5437***	0.5436***	0.5436***	0.4614***	-0.2358***	-.0015

Note. [a] Quantities of initial public offers, [b] percentage of new equities issued, [c] stock turnover, [d] number of advancing issues to declining issues ratio
Level of significance: * 10% ** 5% ***1%

Overall, variables related to investor behavior (turnover and the number of advancing issues to declining issues ratio) seem to reflect investor sentiment a little later than the variables related to firms' decisions to issue (initial and subsequent) stocks. Baker and Wurgler (2006, 2007) found an inverse effect and argued that the decisions to issue and sell stocks are conditioned to the market behavior in the previous months. Considering the strong correlation of the lagged NIPO variable, this difference seems to be related to the large number of IPO that occurred around the middle of 2007, anticipating the stock market high in that period up to the historical record reached in 2008.

In the second step, PCA was run only on selected variables (NEI_{t-1}, $NIPO_{t-1}$, $TURN_t$ and AD_t.). As a result, only the first principal component provided an eigenvalue over 1, explaining 39% of the variance in common, which is a relevant parcel. The high correlation of 0.84 between this first component and that estimated in the previous step implies a low informational loss; however, the use of more proxies could raise this correlation, approximating it to the 0.95 found in the index construction of Baker and Wurgler (2006).

To minimize the effects of the business cycle possibly captured by the index, in this third step the selected proxies were regressed on macroeconomic variables and then a PCA was run using the residuals. The variables used were the variations of the GDP, Selic, unemployment rate, and a dummy for recession periods of the Organisation for Economic Co-operation and Development (OECD). The orthogonalized index estimated on the first principal component explains 40% of the variation in common and is given by Equation 3.

$$SENT_t = 0.39\, NEI_{t-1} + 0.55\, NIPO_{t-1} + 0.53\, TURN_t + 0.42\, AD_t \quad (3)$$

Table 6 shows the correlation of the orthogonalized sentiment index constructed on the other variables, which is, most of the cases, high, except for the equity issuance ratio, which – despite its significant correlation at 10% level – has a low value. Baker and Wurgler's index (2006) showed similar behavior, also with a low correlation of the equity issuance variable with the other variables.

Table 6

Correlation Matrix of the Sentiment Index and Its Variables

	$SENT_t$	$NIPO_t$	NEI_t	$TURN_t$	AD_t	$NIPO_{t-1}$	NEI_{t-1}	$TURN_{t-1}$
$NIPO_t$[a]	0.00	1.00						
NEI_t[b]	0.14*	0.25***	1.00					
$TURN_t$[c]	0.64***	0.11	0.02	1.00				
AD_t[d]	0.51***	-0.20***	0.04	0.10	1.00			
$NIPO_{t-1}$	0.72***	0.14*	0.15**	0.31***	0.17**	1.00		
NEI_{t-1}	0.56***	-0.10	0.25***	0.09	0.17**	0.28***	1.00	
$TURN_{t-1}$	0.11	0.10	0.19***	0.26***	-0.11	0.08	0.07	1.00
AD_{t-1}	-0.03	-0.09	-0.02	0.13*	0.02	-0.17*	0.05	0.11

Note. [a] Quantities of initial public offers, [b] percentage of new equities issued, [c] stock turnover, [d] number of advancing issues to declining issues ratio.
Level of significance: * 10% ** 5% ***1%

Figure 1 presents a plotting of the sentiment index and Ibovespa, both of which were transformed into a common scale to allow comparisons of their variations. Although the limited size of the sample does not cover a period long enough to find patterns in great events, it is possible to notice some correlation between the movement of the sentiment index and that of Ibovespa. In addition, it is possible to identify a rise in investor sentiment at moments before 2008.

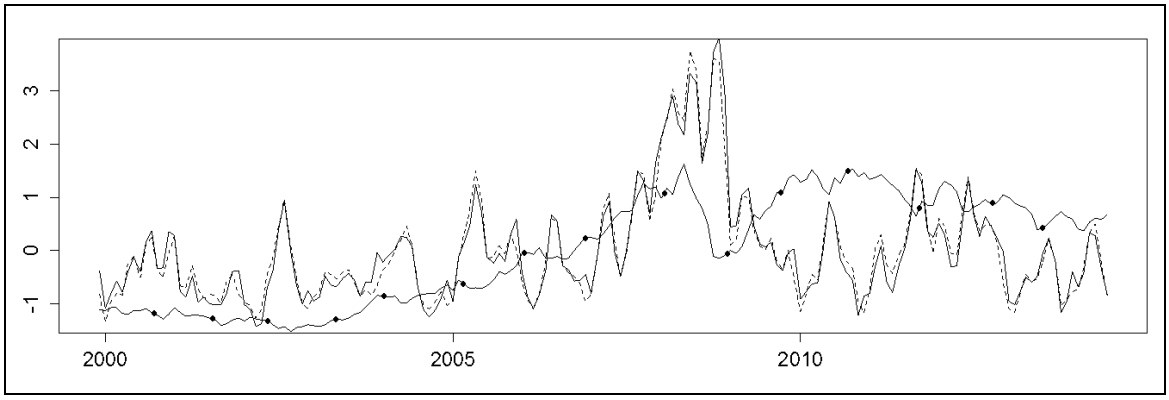

Figure 1. Sentiment Index and Ibovespa

Investor sentiment and anomalies

Explanatory power of the sentiment index to predict returns

Table 7 shows the value of the orthogonalized sentiment index coefficient and the statistical significance. The coefficient is negative and significant in the size anomaly both for the market-value weighted portfolios and for the equally-weighted portfolios. Stambaugh *et al.* (2012) conducted an additional analysis that relates Long-Short portfolios to risk factors, and they found similar results for the size factor. Another factor that provided significant results was liquidity, in this case, only when

market-value weighted. Unlike the findings of Stambaugh *et al.* (2012), Long was the highest position for liquidity.

Table 7

Regressions and Explanatory Capacity of the Sentiment Index ($SENT_{t-1}$)

Panel A	$R_{i,t} = \alpha + bSENT_{t-1} + \varepsilon_{i,t}$					
	Equally-weighted			Value-weighted		
Anomalies [a]	Long	Short	Long-Short	Long	Short	Long-Short
Size	-0.009	-0.003	-0.006*	-0.020**	-0.003	-0.017*
BM	-0.006	-0.006	0.000	-0.003	-0.001	-0.002
Momentum	-0.008	-0.005	-0.002	-0.006	0.002	-0.008*
Volatility	-0.008	-0.004	-0.004	-0.002	-0.004	0.002
Liquidity	-0.005	-0.005	0.000	-0.012**	-0.002	-0.010**
Earnings-to-pricing	-0.007	-0.009	0.002	-0.005	-0.003	-0.002
EBITDA	-0.003	-0.009	0.005	-0.003	-0.005	0.002
Leverage	-0.008	-0.005	-0.002	-0.005	-0.003	-0.002
Growth Sales	-0.006	-0.008	0.002	-0.006	-0.007	0.001
ROA	-0.006	-0.010	0.004	-0.003	-0.005	0.001
Asset Growth	-0.005	-0.008	0.003	-0.001	-0.006	0.005
Investment	-0.005	-0.008	0.004	-0.001	-0.006	0.004
Combined	-0.006	-0.007	0.000	-0.006	-0.004	-0.002
Panel B	$R_{i,t} = \alpha + bSENT_{t-1} + cMKT_t + \varepsilon_{i,t}$					
	Equally-weighted			Value-weighted		
Anomalies [a]	Long	Short	Long-Short	Long	Short	Long-Short
Size	-0.006**	0.000	-0.006	-0.018**	0.001	-0.018**
BM	-0.004**	-0.003	-0.001	0.000	0.002	-0.002
Momentum	-0.005***	-0.002	-0.003	-0.003	0.006	-0.009*
Volatility	-0.005**	-0.001	-0.004	0.001	0.000	0.001
Liquidity	-0.003	-0.001	-0.002	-0.010**	0.002	-0.011***
Earnings-to-pricing	-0.004**	-0.005**	0.001	-0.002	0.001	-0.002
EBITDA	-0.001	-0.006**	0.005	0.000	-0.001	0.001
Leverage	-0.005**	-0.003	-0.002	-0.001	0.001	-0.002
Growth Sales	-0.003	-0.006**	0.003	-0.002	-0.004	0.001
ROA	-0.003**	-0.006**	0.003	0.000	-0.001	0.000
Asset Growth	-0.003	-0.005	0.002	0.001	-0.002	0.003

Continues

Table 7 (continued)

Panel B	$R_{i,t} = \alpha + bSENT_{t-1} + cMKT_t + \varepsilon_{i,t}$					
	Equally-weighted			Value-weighted		
Anomalies [a]	Long	Short	Long-Short	Long	Short	Long-Short
Investment	-0.002	-0.005*	0.003	0.001	-0.002	0.003
Combined	-0.004***	-0.004**	0.000	-0.003***	0.000	-0.003**
Panel C	$R_{i,t} = \alpha + bSENT_{t-1} + cMKT_t + dSMB_t + eHML_t + \varepsilon_{i,t}$					
	Equally-weighted			Value-weighted		
Anomalies [a]	Long	Short	Long-Short	Long	Short	Long-Short
Size	-0.002	0.001	-0.002	-0.014	0.000	-0.014
BM	-0.001	0.000	-0.001	0.000	-0.001	0.001
Momentum	-0.002	0.002	-0.004	-0.001	0.007*	-0.008*
Volatility	-0.001	0.002	-0.003	0.003	0.000	0.003
Liquidity	0.001	0.000	0.001	-0.008*	0.001	-0.008**
Earnings-to-pricing	-0.002	-0.001	-0.001	-0.001	0.003	-0.004
EBITDA	0.001	-0.001	0.002	0.000	-0.001	0.000
Leverage	-0.002	0.001	-0.002	0.000	0.001	-0.001
Growth Sales	0.001	-0.001	0.002	-0.001	-0.001	0.000
ROA	-0.001	-0.001	0.000	0.000	0.002	-0.002
Asset Growth	0.001	0.000	0.001	0.002	0.000	0.002
Investment	0.001	-0.001	0.002	0.001	-0.001	0.002
Combined	0.000	0.000	-0.001	-0.002	0.001	-0.002
Panel D	$R_{i,t} = \alpha + bSENT_{t-1} + cMKT_t + dSMB_t + eHML_t + fUMD_t + \varepsilon_{i,t}$					
	Equally-weighted			Value-weighted		
Anomalies [a]	Long	Short	Long-Short	Long	Short	Long-Short
Size	-0.002	0.001	-0.003	-0.015	0.000	-0.015
BM	-0.001	0.000	-0.001	0.001	-0.001	0.002
Momentum	-0.001	0.001	-0.002	0.000	0.005	-0.005
Volatility	-0.001	0.002	-0.003	0.003	0.000	0.003
Liquidity	0.000	0.000	0.001	-0.008*	0.001	-0.008**
Earnings-to-pricing	-0.002	-0.002	0.000	-0.001	0.002	-0.002
EBITDA	0.001	-0.002	0.003	0.000	-0.001	0.001
Leverage	-0.002	0.000	-0.002	0.000	0.000	-0.001
Growth Sales	0.000	-0.002	0.002	-0.001	-0.001	0.000
ROA	-0.001	-0.002	0.001	0.000	0.001	-0.001

Continues

Table 7 (continued)

Panel D	$R_{i,t} = \alpha + bSENT_{t-1} + cMKT_t + dSMB_t + eHML_t + fUMD_t + \varepsilon_{i,t}$					
	Equally-weighted			Value-weighted		
Anomalies [a]	Long	Short	Long-Short	Long	Short	Long-Short
Asset Growth	0.000	0.000	0.000	0.001	0.000	0.002
Investment	0.001	-0.001	0.002	0.001	-0.001	0.002
Combined	-0.001	0.000	0.000	-0.001	0.000	-0.002

Note. [a] For each of the studied anomalies, Long-Short portfolios were created on the extreme quintiles, 1 and 5, where Long position was the high-performance quintile, depending on the anomaly behavior in the Brazilian market.
Level of significance: * 10% ** 5% ***1%; Standard errors adjusted for serial correlation, using Newey-West 4-lag standard error.

At CAPM, apart from size and liquidity, the spread for the combined portfolio was also significant, where Long was the only significant part. Considering this model, it is possible to see the appearance of anomalies in which the index is significant, especially for the portfolios in which the return is equally-weighted. However, as it is controlled for the three factors of Fama and French (1993), the index loses its predictive power for all portfolios, except for momentum, whose explanation is – right after – absorbed by momentum. One likely justification for such a result is that the sentiment index may have characteristics related to the other risk factors.

The use of the sentiment index changes may be the best alternative as a return predictor. Table 8 shows the significance and the relation of the index changes. The anomalies that are significant in the CAPM, and persist even when the three-factor and four-factor models are used, corroborate Baker and Wurgler (2007), which provided a greater efficiency for the index changes to explain returns more frequently.

Table 8

Regressions and Explanatory Capacity of the Sentiment Index Changes ($\Delta SENT_{t-1}$)

Panel A	$R_{i,t} = \alpha + b\Delta SENT_{t-1} + \varepsilon_{i,t}$					
	Equally-weighted			Value-weighted		
Anomalies [a]	Long	Short	Long-Short	Long	Short	Long-Short
Size	-0.008	0.001	-0.009	-0.013	-0.006	-0.007
BM	-0.007	-0.003	-0.004	-0.002	-0.011	0.010
Momentum	-0.002	-0.003	0.001	-0.012	-0.005	-0.006
Volatility	-0.006	0.001	-0.007	0.003	-0.006	0.010
Liquidity	-0.009	-0.003	-0.006	-0.010	-0.012	0.002
Earnings-to-pricing	-0.006	-0.002	-0.004	0.000	0.000	0.000
EBITDA	-0.001	-0.003	0.002	-0.006	0.001	-0.007
Leverage	-0.005	-0.003	-0.002	0.000	-0.005	0.004
Growth Sales	-0.003	-0.005	0.003	0.001	-0.001	0.003
ROA	-0.005	-0.004	0.000	-0.006	0.006	-0.011
Asset Growth	-0.008	0.007	-0.015***	-0.002	0.008	-0.009

Continues

Table 8 (continued)

Panel A	$R_{i,t} = \alpha + b\Delta SENT_{t-1} + \varepsilon_{i,t}$					
	Equally-weighted			Value-weighted		
Anomalies [a]	Long	Short	Long-Short	Long	Short	Long-Short
Investment	-0.003	0.003	-0.005	0.002	0.009	-0.007
Combined	-0.005	-0.001	-0.004*	-0.004	-0.003	-0.001
Panel B	$R_{i,t} = \alpha + b\Delta SENT_{t-1} + cMKT_t + \varepsilon_{i,t}$					
	Equally-weighted			Value-weighted		
Anomalies [d]	Long	Short	Long-Short	Long	Short	Long-Short
Size	-0.003	0.006**	-0.010	-0.009	0.000	-0.009
BM	-0.003	0.002	-0.005	0.003	-0.006	0.009
Momentum	0.003	0.003	0.000	-0.006	0.001	-0.007
Volatility	-0.002	0.006	-0.008	0.008*	0.000	0.009
Liquidity	-0.005	0.003	-0.009	-0.007	-0.006**	0.000
Earnings-to-pricing	-0.002	0.004	-0.006	0.005	0.006	-0.001
EBITDA	0.003	0.002	0.001	-0.001	0.007	-0.008
Leverage	0.000	0.002	-0.002	0.005	0.001	0.004
Growth Sales	0.003	0.000	0.003	0.007*	0.005	0.002
ROA	0.000	0.001	-0.002	0.000	0.013	-0.013
Asset Growth	-0.004	0.012**	-0.016	0.002	0.014***	-0.012**
Investment	0.002	0.009	-0.007	0.006	0.015***	-0.009
Combined	-0.001	0.004	-0.005	0.001	0.004	-0.003
Panel C	$R_{i,t} = \alpha + b\Delta SENT_{t-1} + cMKT_t + dSMB_t + eHML_t + \varepsilon_{i,t}$					
	Equally-weighted			Value-weighted		
Anomalies [d]	Long	Short	Long-Short	Long	Short	Long-Short
Size	-0.002	0.007**	-0.008*	-0.006	0.000	-0.005
BM	-0.001	0.003	-0.004	0.003	-0.004	0.006
Momentum	0.003	0.004	-0.001	-0.007*	0.002	-0.008
Volatility	0.000	0.007**	-0.007*	0.010**	0.000	0.010*
Liquidity	-0.004	0.004	-0.008	-0.006	-0.007***	0.001
Earnings-to-pricing	-0.001	0.006**	-0.007	0.005	0.008	-0.002
EBITDA	0.003	0.004	0.000	-0.001	0.009*	-0.010**
Leverage	0.001	0.003	-0.002	0.006	0.002	0.004
Growth Sales	0.004	0.001	0.002	0.007*	0.006	0.001
ROA	0.000	0.003	-0.003	-0.001	0.014*	-0.015**

Continues

Table 8 (continued)

Panel C	$R_{i,t} = \alpha + b\Delta SENT_{t-1} + cMKT_t + dSMB_t + eHML_t + \varepsilon_{i,t}$					
	Equally-weighted			Value-weighted		
Anomalies [d]	Long	Short	Long-Short	Long	Short	Long-Short
Asset Growth	-0.003	0.013***	-0.016***	0.003	0.014***	-0.011*
Investment	0.003	0.009***	-0.007	0.007	0.015***	-0.009
Combined	0.000	0.005**	-0.005***	0.001	0.004*	-0.003
Panel D	$R_{i,t} = \alpha + b\Delta SENT_{t-1} + cMKT_t + dSMB_t + eHML_t + fUMD_t + \varepsilon_{i,t}$					
	Equally-weighted			Value-weighted		
Anomalies [d]	Long	Short	Long-Short	Long	Short	Long-Short
Size	-0.002	0.007**	-0.009*	-0.006	0.000	-0.005
BM	-0.001	0.002	-0.004	0.003	-0.004	0.007
Momentum	0.004	0.003	0.001	-0.006*	0.000	-0.006
Volatility	-0.001	0.006**	-0.007*	0.010**	-0.001	0.010*
Liquidity	-0.005	0.003	-0.008	-0.006	-0.007**	0.001
Earnings-to-pricing	-0.001	0.005*	-0.006	0.005	0.007	-0.001
EBITDA	0.003	0.003	0.000	-0.001	0.008*	-0.009**
Leverage	0.001	0.002	-0.002	0.006	0.002	0.004
Growth Sales	0.003	0.001	0.002	0.007*	0.006	0.001
ROA	0.000	0.002	-0.002	0.000	0.013*	-0.014*
Asset Growth	-0.003	0.013***	-0.016***	0.003	0.014***	-0.011*
Investment	0.003	0.009***	-0.007	0.006	0.015***	-0.009
Combined	0.000	0.005*	-0.005***	0.002	0.004*	-0.003

Note. [a] For each of the studied anomalies, Long-Short portfolios were created on the extreme quintiles, 1 and 5, where Long position was the high-performance quintile, depending on the anomaly behavior in the Brazilian market.
Level of significance: * 10% ** 5% ***1%; Standard errors adjusted for serial correlation, using Newey-West 4-lag standard error.

The results obtained by the sentiment index changes are favorable to the hypotheses raised in this work, since all anomalies that had a significant coefficient for Long-Short position also had significance only for the Short coefficients. These results are similar to those found by Stambaugh *et al.* (2012), who argue that this Long-Short power deriving from Short is an evidence of the existence of short-sale constraints. In the market-value weighted portfolios, this happens with asset growth, ROA and EBITDA, whereas in the equally-weighted portfolios, this effect takes place for size, volatility, asset growth anomalies and combined strategy.

For most of the portfolios, there is a negative relation between the sentiment index and the long position, as well as a positive relation between the index and the short position. This result is the opposite of that found by Stambaugh *et al.* (2012) in the US market, and corroborates the findings of Yoshinaga and Castro (2012) for the Brazilian market. Such evidences suggest that, in Brazil, the anomalies are also influenced by a reversion pattern, where excessively optimistic periods tend to be followed by negative returns and vice-versa.

Portfolio performance followed by periods of optimism and pessimism

The second analysis to investigate the relation between anomalies and investor sentiment sought to identify the behavior of the short, long and long-short portfolios in periods of optimism and pessimism. For this, the sample periods were classified as optimistic when the estimated sentiment index was over the median in the previous month.

Table 9

Average Returns after Periods of Optimism and Pessimism ($SENT_{t-1}$)

Panel A – market-value weighted									
	Long			Short			Long-Short		
Anomalies [d]	O [a]	P [b]	O – P [c]	O [a]	P [b]	O – P [c]	O [a]	P [b]	O – P [c]
Size	2.16***	6.19***	-4.04*	0.42	0.21	0.21	1.74**	5.99	-4.25
BM	0.29	0.52	-0.23	0.74	-0.41	1.14	-0.45	0.92	-1.37
Momentum	0.42	0.76	-0.34	1.26	-0.87	2.14	-0.85	1.63	-2.48
Volatility	1.24*	1.25*	-0.01	-0.58	-0.54	-0.04	1.82***	1.78	0.04
Liquidity	1.24*	1.74**	-0.50	0.68	-0.04	0.72	0.56	1.78	-1.22
Earnings-to-pricing	1.01*	1.39**	-0.38	-0.02	-0.66	0.64	1.03*	2.05	-1.02
EBITDA	0.71	0.72	-0.01	0.82	0.54	0.28	-0.11	0.18	-0.29
Leverage	0.54	1.02*	-0.48	0.11	-0.34	0.44	0.43	1.36	-0.93
Growth Sales	0.54	0.70	-0.16	-0.03	0.73	-0.76	0.57	-0.03	0.61
ROA	0.74	0.88*	-0.14	-0.62	-0.77	0.15	1.37**	1.65	-0.28
Asset Growth	0.85*	0.10	0.75	-0.10	0.39	-0.49	0.95	-0.30	1.25
Investment	0.49	-0.08	0.57	-0.19	0.32	-0.51	0.67	-0.40	1.08
Combined	0.80	1.24**	-0.43	0.16	-0.17	0.32	0.65**	1.40	-0.76
Panel B – Equally-weighted									
	Long			Short			Long-Short		
Anomalies [d]	O [a]	P [b]	O – P [c]	O [a]	P [b]	O – P [c]	O [a]	P [b]	O – P [c]
Size	-0.50	0.43	-0.93	-0.37	-0.60	0.22	-0.13	1.03	-1.16
BM	0.27	0.13	0.14	-1.01	-0.83	-0.18	1.28***	0.96	0.32
Momentum	-0.29	0.03	-0.32	-0.74	-1.06	0.32	0.45	1.09	-0.64
Volatility	-0.16	0.76	-0.92	-0.93	-1.71	0.79	0.77*	2.48	-1.70
Liquidity	0.26	-0.06	0.32	-1.08	-1.01	-0.07	1.34**	0.95	0.40
Earnings-to-pricing	0.36	0.79*	-0.44	-1.34*	-1.24	-0.10	1.69***	2.03	-0.33
EBITDA	0.44	0.08	0.36	-1.21	-0.80	-0.41	1.65***	0.87	0.77
Leverage	-0.15	0.04	-0.19	-0.28	-0.53	0.25	0.13	0.56	-0.43
Growth Sales	0.16	-0.24	0.41	-1.04	-0.40	-0.64	1.21***	0.15	1.05*
ROA	0.37	0.45	-0.08	-1.43*	-0.55	-0.87	1.80***	1.01	0.8

Continues

Table 9 (continued)

Panel B – Equally-weighted

	Long			Short			Long-Short		
Anomalies [d]	O [a]	P [b]	O – P [c]	O [a]	P [b]	O – P [c]	O [a]	P [b]	O – P [c]
Asset Growth	-0.39	-0.34	-0.04	-0.59	-0.40	-0.19	0.20	0.06	0.14
Investment	-0.09	-0.40	0.31	-0.80	-0.26	-0.54	0.71	-0.14	0.85
Combined	0.02	0.14	-0.12	-0.90	-0.78	-0.12	0.92***	0.92	.003

Note. [a] O: Periods of Optimism. [b] P: Periods of Pessimism. [c] O – P: Periods of Optimism minus Periods of Pessimism. [d] for each of the studied anomalies, Long-Short portfolios were created on the extreme quintiles, 1 and 5, where Long position was the high-performance quintile, depending on the anomaly behavior in the Brazilian market.
Level of significance: * 10% ** 5% ***1%; Standard errors adjusted for serial correlation, using Newey-West 4-lag standard error.

Table 9 shows the average return values for each portfolio after a period of optimism and pessimism. The significance tests were unicaudal for the expected sign, according to hypotheses 2 and 3 of this research. In hypothesis 2, returns followed by optimistic periods (O) are expected to be higher than the returns followed by pessimistic (P) periods, and the spread (O – P) must be below zero when returns are negative, which is the case of the Short position, and it must be over zero when returns are positive, as in the Long and Long-Short positions.

In the market-value weighted portfolios, of the 12 tested anomalies, the Long position showed significant positive returns after the optimistic months for five anomalies as opposed to six anomalies after pessimistic periods; the power of the optimistic moment is greater than that of the pessimistic moment only for size, with a return of -4.037 significant at the 10% level. These results imply that, although there is a relation between returns and investor sentiment, optimistic periods do not show a greater power than pessimistic periods for the Long position.

The Short position showed only six portfolios with a negative return after optimistic periods. After pessimistic periods, only five portfolios showed positive returns, and only four anomalies provided negative return on the difference between positive and negative returns. In addition, in no situation did the Short position show statistically significant returns, contradicting the findings of Stambaugh *et al.* (2012) and, consequently, by analysis of the behavior of Long-Short anomaly-based portfolios and periods of optimism and pessimism, it is not possible to confirm the existence of short-sale constraints, according to previously documented evidences in Brazil (Bonomo *et al.*, 2015; Chague *et al.*, 2014, 2017).

For the Long position, only optimism provided subsequent positive returns; however, no significant and negative returns were found for the difference between the optimistic and pessimistic periods, as expected. It is important to highlight that the returns for the size, volatility and earnings-to-pricing portfolios provided a positive and significant average after the optimistic periods, and its power comes from the Long position, going against the findings of Stambaugh *et al.* (2012). Concerning size and volatility, the highest returns are in the Long position, which belong to portfolios that were formed by hard-to-arbitrage firms, since they are small and volatile, therefore suggesting a greater influence from the investor sentiment index, according to the findings of Baker and Wurgler (2006, 2007).

The equally-weighted portfolios also provided no evidence of short-sale constraints. The results were similar to those obtained for market-value weighted portfolios; the difference lies in the Long-Short position combined portfolio, which was significant and seems to be greater for the equally-weighted portfolios than the market-value weighted portfolios. This can be a result of a greater influence of small firms on these portfolio returns, a reason for which Baker and Wurgler (2006) affirm that equally-weighted portfolios are more susceptible to the influence of investor sentiment.

The average returns classified on the median of the index of sentiment changes ($\Delta SENT_{t-1}$) provide similar results to the previous ones. Qualitatively, there is no evidence of short-sale constraints. Overall, the sign and power of each position were kept. The table containing the coefficients of the $\Delta SENT_{t-1}$ index was omitted due to space limitation but it can be provided upon request to the authors.

As explained above, both for the model using the sentiment index and its variance, only in some anomalies are price deviations caused by optimistic investors different from the deviations caused by pessimistic investors, going against the findings of Stambaugh *et al.* (2012), possibly due to the reversion effect found in the relation between investor sentiment and returns in the Brazilian market (Yoshinaga & Castro, 2012). However, the difference between the effect of optimism and pessimism is not consistent and, consequently, the results obtained on the analysis of Long-Short anomaly-based strategies in this study do not support the existence of short-sale constraints.

The results presented do not follow the evidences existing in the Brazilian market (Bonomo *et al.*, 2015; Chague *et al.*, 2014, 2017), that is, it was not possible to confirm the existence of short-sale constraints through the analysis of Long-Short anomaly-based strategies. It must be said that the limited size of the studied series compared to international studies may have made it difficult to compare the Long and Short positions, periods of optimism and pessimism. Stambaugh *et al.* (2012), for example, analysed time series of, at a minimum, 408 months, while this study analysed time series of only 156 months. Considering this limitation, the results found do not imply inexistence of short-sale constraints, rather, it was just not possible to confirm its existence through the analysis of Long-Short anomaly-based strategies.

Conclusion

This paper aimed to analyze whether there is a relation between investor sentiment and market anomalies in Brazil. In addition, it sought to verify if the price deviations caused by optimistic investors are different from those caused by pessimistic investors. To measure investor sentiment, this study used the Principal Components Analysis multivariate technique to capture the component common to four different proxies for market behavior. The way investor sentiment relates to the anomalies was tested empirically over the series of returns for the long, short and long-short position portfolios of 12 anomaly-based strategies, as well as the series of the sentiment index constructed and its variance from one month to another.

There were not enough statistically significant values in the analysis of the average returns after periods of optimism and pessimism to infer the possible existence of short-sale constraints. This is even though for part of the anomalies the spread between the average return after optimistic and pessimistic periods had the expected sign, indicating a greater influence of optimism.

When testing the explanatory power of the future return index, the measure of the sentiment index showed an explanatory power for part of the anomalies only when included in the CAPM. When controlling for the three-factor and four-factor models, the coefficient loses its statistical significance. One possible explanation for this result is that the sentiment index may contain characteristics related to other risk factors.

When using the index of sentiment changes as an explanatory variable, a relation to the future returns was verified, robust to all risk factors. Given these evidences, hypothesis 1 – that it is possible to relate the investor sentiment index to the returns of portfolios formed on value anomalies – cannot be rejected. However, hypotheses 2 and 3, concerning the existence of short-sale constraints, were not confirmed by the empirical tests.

The results found do not confirm the previous studies that show the existence of short-sale constraints in Brazil (Bonomo *et al.*, 2015; Chague *et al.*, 2014, 2017). We believe that this difference results from the limited size of the studied series compared to international works. Therefore, it is

important to highlight that, even though it was not possible to confirm the existence of short-sale constraints through anomaly-based Long-Short strategies, the results found do not suggest that constraints are inexistent in the Brazilian market. Further studies are required.

Therefore, the results reached by this work contribute to the literature on asset pricing and its anomalies, as it produces evidences that they can be explained, even if only partially, by a behavioral component. In addition, the presented evidences demonstrate that the number of IPOs occurring in a period, the ratio of equity issuance and debts, turnover, and the number of advancing issues to declining issues ratio can help measure investor sentiment on a monthly basis.

Regarding practical implications, the evidences concerning the different anomaly-based strategies may assist investment managers' decision-making and, therefore, improve the portfolio composition and performance. In addition, by producing evidence that the anomalies partially reflect behavior-related mispricing, this study may motivate the search for policies to make the market more efficient and, consequently, more attractive to foreign capital and the productive sector.

However, the validity of the results of this research must be faced with caution. In terms of theoretical limitations, it is noteworthy that Brazilian studies are scarce, which makes it difficult to support a sentiment index for Brazil. In addition, the sentiment index on which this research was based – although vastly used in international empirical studies – may not reflect a behavior-based price deviation. Therefore, even though this study used the same procedure used by Baker and Wurgler (2006) to expunge the business cycle components from the index, the index may still have characteristics related to macroeconomic factors (Sibley, Wang, Xing, & Zhang, 2016).

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