Study of Market Sentiment and Capital Investment of Brazilian companies

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Abstract

We examine the process through which Brazilian companies make investment decisions, particularly whether this process is affected by the market sentiment. Firstly, we create an index that represents the market sentiment at some point in time. With data regarding 2000-2010, we do the econometric analysis. Such index is the explanatory variable of investments made by selected Brazilian companies in this period. Using different econometric methods and modifying the original model, we conclude that market sentiment is the only explanatory variable that always shows statistical significance, which corroborates the hypothesis that this variable is strongly related to the companies' investment decisions.

1. Introduction

In recent decades, various studies have been made seeking to enhance the classical theoretical models of finances incorporating behavioral aspects previously unconsidered, thus giving rise to behavioral finance. The rise of this non-traditional approach has been motivated especially by the attempt to explain phenomena observed frequently in financial markets that are incompatible with the predictions of traditional models.

Baker and Wurgler (2007) state that traditional finance theory, based on investors free of emotions, who always force the prices of assets to be the same as the present net value less the future cash flows has faced ever more difficulty in explaining events. In this context, sentiment, in general, can be defined as a belief about future cash flows and investment risks that is not rationally justifiable from the information content that the investor or business manager has available to take the decision.

The taking of the decision is at the crux of the concept of management, and in a context of corporate finance, there are three big decisions involved: investment decisions, financing decisions and dividends or reinvestment decisions. Thus, we are seeking to analyze whether an investment decision is influenced by behavioral factors such as the level of market sentiment. If so, the effort to try and understand how behavioral aspects influence business decisions in the context of finance theory would be justified.

The basic objective of the study is to identify causal relationships between market sentiment and the flow of investments in capital assets made by Brazilian companies. If this is found to be true, then there will be empirical evidence

that financial decisions are influenced by behavioral aspects of the agents and of the market as a whole, and that the theory has to evolve and try to incorporate variables which have been ignored up until now and which have been found to be relevant in the studies.

Investment decisions is the first and most important corporate finance decision. According to Damodaran (2002), investment decisions do not include only those that generate revenue and profits, but also those that save resources. Included in this group are all the decisions related to the operational part of the company, for example such as the launch of new products, efficient distribution systems, stock management, policy on turnover capital, as well as decisions which involve market strategy and acquisitions of other companies. The criteria for approval of an investment always has to measure the relationship between costs and benefits of the project. The returns have to be measured on the basis of the cash flows generated by the project and on the timeline for their occurrence.

With this objective, the idea is to analyze whether an investment decision taken by the managers of companies that have stocks traded on the BM&FBOVESPA stock exchange is influenced by the level of market sentiment, and is not just a decision taken in a context of the company's investment opportunities.

As a secondary objective, a comparison will be made between the results of these relationships in each one of the sectors of the Brazilian economy.

2. Methodology

The methodology for estimation of the level of market sentiment variable (*Sent)* is Principal Components Analysis (PCA). This is a technique used for the reduction and interpretation of data. According to Johnson and Wichern (2002) the information of a group of p variables can be explained by k linear combinations called components. The steps in carrying out the method, according to Washington, Karlaftis and Mannering (2003), are: (a) calculate the covariance or correlation matrix; (b) find the eigenvalues and eigenvectors and (c) select the components that best summarize the information.

In step (a) there is the decision as to which matrix is to be used; thus, according to Borgognone, Bussi and Hough (2001) if the variables are measured on different scales, the use of the correlation matrix is recommended; given that the variances are standardized for units and the covariances in correlations. If the covariance matrix is used, then the larger variances will have a greater impact on the analysis without leading to better quality of summarized information.

For step (b), Ferreira (1996) demonstrates that from a covariance or correlation matrix Σ, the k principal components are represented by the linear combinations

$$Y_p = \underset{\sim}{\mathbf{e}}^{t}_{p}\underset{\sim}{\mathbf{X}} = e_{p1}X_1 + e_{p2}X_2 + \ldots + e_{pp}X_p \quad (1)$$

being represented by the quadratic form $\underset{\sim}{\mathbf{e}}'\underset{\sim}{\Sigma}\underset{\sim}{\mathbf{e}}$, and the maximization of this model takes place using

$$(\Sigma - \underset{\sim}{\lambda_i} I)\mathbf{e} = \underset{\sim}{\mathbf{0}} \quad (2)$$

where, λ_i - eigenvalues, e_i – eigenvectors; and from this, the spectral decomposition of Σ can be carried out as shown in equation 3.

$$\Sigma = \underset{\sim}{\lambda_1}\underset{\sim}{\mathbf{e}}_1\underset{\sim}{\mathbf{e}}_1^{t} + \underset{\sim}{\lambda_2}\underset{\sim}{\mathbf{e}}_2\underset{\sim}{\mathbf{e}}_2^{t} + \cdots + \underset{\sim}{\lambda_n}\underset{\sim}{\mathbf{e}}_n\underset{\sim}{\mathbf{e}}_n^{t} \quad (3)$$

Thus, the eigenvalues give information on the number of components in which the variables will be summarized and their respective eigenvectors will be the entries of the *e* parameters in equation 1.

Lastly, on the criteria for selection of the number of components, Hair Jr et al (2009) advise the combination of a qualitative appraisal be made, i.e. from the conceptual grounds and quantitative criteria. Conceptually, one would expect the set of variables to be summarized into a single component that will be called "market sentiment". As for the quantitative criteria, the Kaiser criteria (eigenvalue) and parallel analysis was adopted.

The Kaiser criteria adopted (eigenvalue) is based on the selection of components with eigenvalues of more than 1 ($\lambda > 1$) . According to Jolliffe (2002) the justification for this is in the fact that if all variables are not correlated between each other, each eigenvalue will be equal to 1. This means the information contained in the component is so small and is even less when compared with variables that have no correlation.

Another criteria, parallel analysis, is appropriate for sample data (Crawford et al, 2010); i.e. criteria such as the eigenvalue ($\lambda > 1$ or $\lambda > 0$) are well behaved in population data. However, they are not very precise when the amount of data is low. Thus, Horn (1965) proposed parallel analysis; the method is based on the generation of multiple information banks derived from random data.

As for the creation of the random data, Crawford et al (2010) mention that there are two forms of generating the data banks; the first would be by creation of simulated data from permutations of the existing data (resampling), and the second would be to generate the data banks assuming an expected probability distribution (for example, a normal distribution). However, according to the authors, there is no significant difference between the methods, and thus the second form was preferred as it was quicker in computing terms.

After the creation of these data, their eigenvalues are calculated, and the mean of these eigenvalues is compared to the eigenvalues found in the empirical sample. The components whose eigenvalues were larger than their respective ones generated from simulated data are to remain in the model, otherwise they are considered spurious (Franklin, 1995).

In this study, the stages used for the construction of the market sentiment index follow the propositions of Yoshinaga (2009) and Yoshinaga (2010) for the Brazilian market. In all, the process can be described in four stages.

In the first stage, an index of sentiment was created by means of the PCA, using the five variables proposed in Yoshinaga (2009), i.e. S_t, $Nipo_t$, $Turn_t$, Div_t and $Trin_t$, together with the same ones dephased by one period (S_{t-1}, $Nipo_{t-1}$, $Turn_{t-1}$, Div_{t-1} and $Trin_{t-1}$) forming ten variables in all. This was done due to the need to evaluate the time factor, as some variables may have reflections of the sentiment in a contemporaneous or in a dephased manner. To select the number of components, the two criteria described earlier were adopted (Kaiser and parallel analysis), expecting just one component to be retained in the analysis.

In the second stage, after extracting the component(s), their degree of association was verified with the ten variables used to make up the index(ices) through the correlation coefficient. Each pair, for example, S_t and S_{t-1}, was compared from the degree of association, selecting just one of them to form the index of market sentiment (for example, S_t or S_{t-1}, Div_t or Div_{t-1}) provided there was a significant correlation. The idea in this second stage is to reduce the number of variables from ten to five to make up the index, as well as finding the time variable.

In the third stage, after the selection of the five variables, a further PCA was carried out to form the index of sentiment to be analyzed later. Once more, the Kaiser criteria and parallel analysis were adopted to extract the component(s). Lastly, the expected sign was evaluated with the sign observed from the variables in this study in relation to the work of Yoshinaga (2009).

To analyze whether market sentiment explains the investment decision of the managers, the basic methodology is of linear regression analysis with the data in panel using the methods of estimation of grouped data (POLS), fixed effects (EF) and random effects (EA). This regression has the following general form:

$$\frac{I_{i,t}}{A_{i,t}} = \alpha_i + \beta_1 Perf_{i,t} + \beta_2 Alav_{i,t-1} + \beta_3 Sent_t + \beta_4 d_{SETOR} + \varepsilon_{i,t} \quad (4)$$

The variables of this equation correspond to:

i) $A_{i,t}$: total assets of company *i* in period *t*

ii) α_i : fixed effect of company *i*

iii) $Perf_{i,t}$: performance variable of company *i* in the period *t*. Measured by the ratio between Operating Profits and Operating Revenue of company *i* in the period *t*

iv) $Alav_{i,t-1}$: degree of indebtedness variable of the company. Measured by the ratio between Gross Debt and Total Assets of company *i* in the period *t-1*

v) $Sent_{i,t}$: level of market sentiment in the period *t*

vi) d_{SETOR} : dummies to identify each sector

vii) $\varepsilon_{i,t}$: regression error term

The investment variable, $I_{i,t}$, is calculated from the following equation:

$$I_{i,t} = (Imob_{i,t+1} - Imob_{i,t}) + (CCL_{i,t+1} - CCL_{i,t}) + \frac{Depre_{i,t}}{4} \quad (5)$$

In equation 5, $Imob_i$ corresponds to the total fixed assets of company *i*, CCL_i is its net current capital and $Depre_{i,t}$ is the depreciation of the company. It is important to note that there is a difference of periodicity between these variables: the first two are quarterly (like all the others used in the model) and the last is annual. For this reason, a linear apportionment of the depreciation of the company is done for each of the quarters.

This regression should indicate whether there is a direct relationship between the volume of investment proportional to the size of the assets the company made and the level of market sentiment, with this effect being controlled by the performance, indebtedness variables and separated by sector of activity.

The division of companies by sectors follows the sectorial classification of the Economatica system.

3. Results

3.1 Construction of the index of sentiment

The results are given below in accordance with the stages set forth in the methodology, with the results of the correlations and of the behavior of the index are compared with Yoshinaga's results (2009). As described in the methodology, the "sent10" index was constructed, and from this, we sought to analyze the degree of correlation between the

index and the variables that formed it. Table 1 shows the results, where the letter “l” is a prefix to the variable this denotes its dephased value of a period.

Table 1 – Correlation “sent10” and index of sentiment variable

Variable	Correlation "sent10" (YOSHINAGA, 2009)	Correlation "sent10" (current)
s	0.4510**	0.6134**
LS	0.4262**	0.5537**
NIPO	0.8614**	0.6291**
Lnipo	0.8160**	0.5520**
Turn	0.7839**	0.7646**
Lturn	0.7916**	0.8081**
Div	-0.4795**	-0.6240**
Ldiv	-0.7036**	-0.6627**
Trin	-0.3323*	-0.2936*
Ltrin	-0.3009†	-0.3618*

Level of significance: †: 10%, *:5%, **:1%; n = 47 observations
Source: The authors

From Table 1 the time factor of the variable can be defined in relation to the index to estimate a new PCA. In making the comparison with Yoshinaga (2009) the significances are improved, principally due to the increase of sample size, but the coefficients showed some variations, and the signs stayed the same.

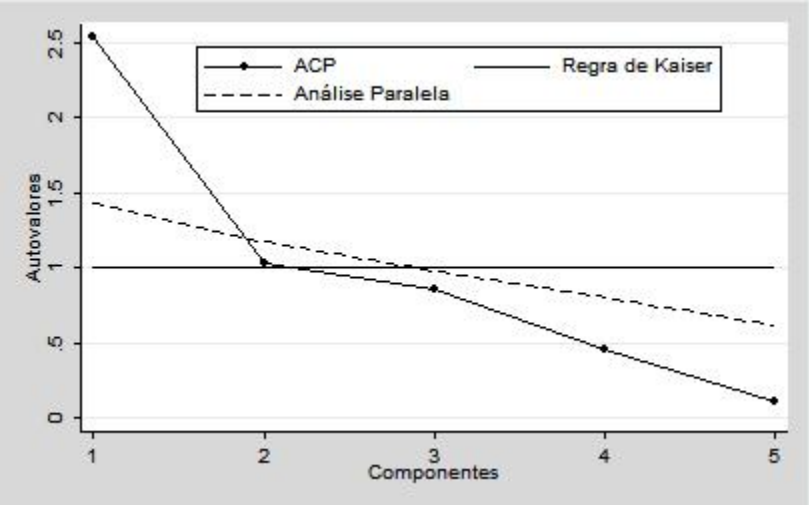
The notable difference between the two analyses was the selection of the “ltrin” variable for a coming stage. In the previous study the dephased variable was not selected. It should be pointed out that in Yoshinaga (2009) it was expected that the variable “ltrin” would be selected at this stage, but the results were not consistent at the time of the study, but with the updating of the data (and increase in sample sizes) the expected and empirical results showed the consistency expected.

Given these results, continuing to the third stage of carrying out a new PCA, but this time only with the variables selected in this stage two (s, nipo, lturn, ldiv, ltrin), Table 2 and Graph 1 show the results of the PCA and of the selection criteria of the components respectively.

Table 2 – Index of sentiment Eigenvalues

Component	Eigenvalue	Proportion	Accumulated
1	2.1876	0.437529	0.437529
2	1.0141	0.202824	0.640353
3	0.784	0.156803	0.797156
4	0.5826	0.116522	0.913678
5	0.4316	0.086322	1

Source: The authors



Graph 1 – Screeplot criteria for selection of the components
Eigenvalues

Source: The authors

From the results, the differences can be seen in relation to the results of the criteria by Kaiser rule and by parallel analysis. In the first criteria the choice of two components is suggested (with explained variance of 64.03%); however, due to the fragility of the criteria in sample data (Crawford, 2010), besides the divergence from the conceptual aspects (one component to represent the index) the result of the parallel analysis was appraised, i.e. only one component was extracted.

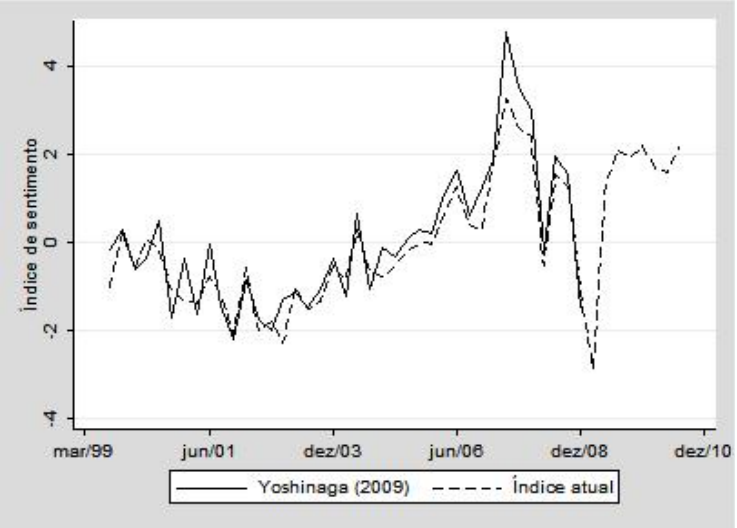
One point that would be worthy of attention in later analyses is the impact of the information of the component extracted in this study (explained variance of 43.75%) in relation to the work of Yoshinaga (2009), which gave explained variance of 49.03%. In other words, in making the regressions where the significance of the index is compromised, it is possible that this loss of information may be one of the causes.

In the last stage of the PCA, an evaluation of the sign of the components of the index of market sentiment is sought. In Yoshinaga's work (2009), the equation was as follows:

$$\mathbf{Sent(2009) = 0,3941S_t + 0,5574NIPO_t + 0,4796TURN_{t-1} - 0,4802DIV_{t-1} - 0,2708TRIN_t} \quad (5)$$

$$\mathbf{Sent(atual) = 0,4740S_t + 0,4263NIPO_t + 0,5109TURN_{t-1} - 0,5082DIV_{t-1} - 0,2725TRIN_{t-1}} \quad (6)$$

In comparing equation 4 with the current index (equation 5), we see there is an increase in the coefficients, but the signs of the variables do not change in the two equations. Graph 2 shows the behavior of the index.



Graph 2 – Evolution of the index Yoshinaga (2009) vs. current index

Source: The authors

3.2 Analysis of the significance of market sentiment

Table 3 below shows the results of the estimation of correlations between the dependent variable ("inv" in the table) with each one of the explanatory variables (alav, perf, sent) and with these dephased in a period (lalav, lperf, lsent). This estimation is important to answer a recurring question in regard to the result sought in this study: does the explanatory variable in question affect the company's investment decision immediately or is there a delay between the general sentiment of the market at a given time and its reflection on the taking of decisions in the companies?

Table 3. Correlation between explanatory variables and that explained

Variable	Obs	Mean	Deviation	Correlation with inv
Inv	4867	0.3438	1.9153	1.000
alav	4894	0.2698	0.2115	0.0244
lalav	4893	0.2699	0.2115	0.0543*
perf	4653	0.1279	0.2041	-0.0560*
lperf	4652	0.1279	0.2041	-0.0388*
sent	4896	0.3216	1.5679	0.0905*
lsent	4895	0.3218	1.5680	0.0685*

*significance $p< 0.05$
Source: The authors

The results in Table 3 provide an empirical basis for the decision to make the estimation of model 4 using contemporaneous explanatory variables with the dependent variable, with the exception of the variable $Alav$, and indicate that the answer to the previous question is that market sentiment has a more immediate effect on investment decisions. Thus, the company's performance and market sentiment variables have higher correlation to the investment variable than that of their dephased values in a period and the dephased indebtedness variable in a period has a closer relationship to the investment variable than its contemporaneous version.

Table 4 shows the results of the estimation carried out according to all the previously mentioned methods. The results according to all the estimation methods are unanimous in pointing toward market sentiment having a statistically significant and positive beta, i.e. it does in fact explain the investment decisions of the company. The other explanatory variables also showed statistically significant coefficients. The table also shows the results for the coefficients of the sector dummies. Only the coefficient of the sector 16 dummy, Software and Data, is statistically significant at 5% in the two estimation methods for dummies. Still considering the 5% level significance, the coefficients of sectors 8 and 14, Industrial Machines and Chemicals, respectively, are also significant in the POLS estimation method. These results indicate that the companies of these three sectors systematically showed higher investments in relation to their total assets. Table 4 below contains only the coefficients of the non-dummy explanatory variables, so as not to get in the way of the reading excessively large tables. The tables below which contain the results of dummies also use the same procedure.

Table 4. Results of the estimations

Variable	POLS	POLS d	FE	RE
Const.	0.260***	-0.416	0.246***	0.293***
lalav	0.450***	0.612***	0.533***	0.477***
perf	-0.499***	-0.576***	-0.503**	-0.468***
sent	0.138***	0.137***	0.109***	0.115***
Multic.[1]	1.050	3.49	1.050	1.050
Heter.	(0.00)[2]	(0.00)[2]	(0.00)[3]	-
Autoc.[4]	(0.00)	(0.00)	(0.00)	(0.00)

[1]VIF – Variance Inflation Factors, [2]White Test, [3]Wald Test for heteroscedasticity in fixed panel effects, [4]Wooldrige self-correlation Test in panel, p values in brackets.
Significance for *** p<0.01; ** p<0.05; * p<0.1.
Source: The authors

Table 5 shows the results for the standardized betas of the explanatory variables. These results indicate that, although table 4 shows lower coefficients for the market sentiment variable than for the other two explanatory variables, the variable with the highest explanatory power for the investment of companies is that of market sentiment, as it has a higher standardized beta, therefore corroborating the initial hypothesis of this study.

Table 5. Standardized coefficients

Variable	POLS	POLS d	FE	RE
Const.	-	-	-	-
lalav	0.04969	0.06758	0.05886	0.05267
perf	-0.0532	-0.0614	-0.0536	-0.0499
sent	0.11297	0.11215	0.08923	0.09414

Source: the authors

Finally, three statistical tests were carried out to compare the methods of estimation used. The Chow test indicated that between POLS and the fixed effect, the latter is better, the Breusch-Pagan test indicated that that the random effect method is better than the POLS method and the Hausman test indicates that the random effect method is better than that of the fixed effect. Table 6 shows these results.

Table 6. Results of the estimations

Models	Chow Test	Breusch-Pagan Test	Hausman Test
	H0: POLS	H0: POLS	H0: RE
	Ha: FE	Ha: RE	Ha: FE
POLS vs. FE	(0.00)	-	-
POLS vs. RE	-	(0.00)	-
POLS d vs. RE d	-	(0.00)	-
FE vs. RE	-	-	(0.259)
FE vs. Re d	-	-	(0.449)

p values in brackets; $p<0.05$ rejects H0.
Source: The authors

3.3 Inclusion of the new variables and new econometric methods

As a complement to the estimations carried out, new estimations were made with the new explanatory variables and using other econometric methods in addition to those already used. These new estimations include the use of the GMM differences method and the systemic GMM for estimation of the parameters of the original model and the inclusion of the dephased sentiment variable in the explanatory variables and the inclusion of the time dummies in the model.

The objective of these changes was to verify the robustness of the results found in session 3.2. The standard of behavior shown in the results from these new estimations is that the market sentiment variable was the only explanatory variable that remained statistically significant in all the new estimations carried out. These results indicate robustness of the results previously found.

4. Conclusions

The objective of this study was to extend the work by Yoshinaga (2009) in which the author concludes that there is a statistically significant relationship between market sentiment and the performance of the Brazilian stock market in the context of taking investment decisions in Brazilian companies. To this end, the first step was to update the index of market sentiment for the data up to 2010 and the methodology used was Principal Components Analysis (PCA).

Then, from the new index of market sentiment, a new econometric model was estimated which had the company's investment as the dependent variable and the performance variable, the leverage variable of the previous period and the market sentiment index as explanatory variables. The decision to use the contemporaneous variables (such as the performance variable and the market sentiment index) or the dephased ones in the estimation was based on their correlation with the dependent variable. Only with the leverage variable was a stronger dephased relationship found than the contemporaneous relation to the companies' investment.

The econometric model was estimated using three different methodologies: grouped data (POLS), fixed effect (EF) and random effect (EA). The three methods were unanimous in indicating a positive and statistically significant coefficient for the market sentiment index, i.e. market sentiment is a relevant factor in the investment decisions of the companies and the better the market sentiment, the more companies will invest. The estimated beta, which oscillated between 0.109 and 0.138, indicating that for every increase of one unit in the index of market sentiment, there is an increase of 0.109 to 0.138 in the company's investment. This result corroborates the initial working hypothesis.

The results also indicate that the dephased coefficient of the leveraging variable is positive and significant, indicating that the leveraged companies in one period invest more in the next period and that the coefficient of the performance variable is negative and significant (in the case of the estimation by Fixed Effect, the coefficient is significant at 10%). This last result allows one to conclude that badly performing companies tend to increase the volume of investments, possibly seeking to reverse this situation.

The model was also estimated using dummies for the sectors, according to the POLS and EA methods. Only the Software and Data sector showed a positive and significant coefficient in the two estimations, indicating a direct relation between being part of this sector and making a higher volume of investments. In the estimation by POLS with dummies, the Industrial Machines and Chemicals sectors also showed positive and significant coefficients.

In addition, statistical tests were carried out comparing the three methods of estimation used and these indicated better estimation by random effect, and the coefficients of the dependent variables were standardized. This standardization

indicated that the index of market sentiment shows a stronger relationship with the investment of the companies, explaining this better, corroborating the initial hypothesis of this study.

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