



# Investor sentiment, economic uncertainty, and monetary policy in Brazil<sup>\*,\*\*</sup>

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## ABSTRACT

The aim of this study is to analyze how economic uncertainty and monetary policy affect investor sentiment in Brazil. Investor sentiment is an important element in the finance, economics, and accounting literature and its impact on financial markets is widely documented. However, understanding the variables that affect it remains an important challenge, and this research seeks to explore this gap within the Brazilian context. The study provides initial evidence regarding the impact of economic uncertainty and monetary policy on investor sentiment in Brazil. The findings documented here provide theoretical, managerial, and social contributions, with a possible impact on the areas of finance, economics, and accounting. Monthly data were used relating to four mechanisms of transmission of economic uncertainty and of monetary policy (interest rate, exchange rate, inflation rate, economic uncertainty index) and to the consumer confidence index as a proxy for investor sentiment (covering the period from January of 2006 to March of 2020). An autoregressive distributed lag model was estimated to capture short- and long-term relationships between the variables. The results indicate that investor sentiment is affected by economic uncertainty and by the main mechanisms of transmission of monetary policy to different extents and in the different time horizons. The evidence suggests that investors, policymakers, and monetary authorities should consider sentiment as a signal, whether for altering investment portfolios or for anticipating economic trends. It also provides support for focusing on economic and monetary policy in the National Financial Education Strategy (*Estratégia Nacional de Educação Financeira* – ENEF) recently adopted in Brazil

**Keywords:** investor sentiment, economic uncertainty, monetary policy, behavioral finance.

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## 1. INTRODUCTION

One of the main topics discussed in finance is the validity of the assumptions made by modern finance theory, in particular the rationality of economic agents. The bounded rationality behavioral model developed by Simon (1955) contributes significantly to this discussion by proposing an alternative to the traditional axioms of rationality. According to the author, rationality is bounded due to restrictions on our capacity to think, the information available, and time (Simon, 1955, 1982). However, it was based on the seminal work of Kahneman and Tversky (1979) and the numerous subsequent studies (Akerlof & Shiller, 2009; Daniel et al., 1998; De Long et al., 1990; Lee et al., 1991; Shleifer & Summers, 1990) that it has been found that some phenomena are caused by the presence of investors that are, in fact, not totally rational, as they trade in accordance with their sentiments. This finding has caused a paradigm shift by considering that people do not always behave rationally when making financial decisions (Baker & Wurgler, 2007).

Investor sentiment can be defined as beliefs about the future cash flows and risks associated with investments that cannot be explained by the information available to the investor, and so they are not rationally justifiable (Baker & Wurgler, 2007). It is also defined as the optimism or pessimism with regards to stocks and is a factor that is considered to have a potential impact on the future performance expectations of companies (Bergman & Roychowdhury, 2008). The ability of the behavioral approach to explain phenomena that are not totally elucidated by the conventional theories has motivated the development of many studies within the international arena (Akerlof & Shiller, 2009; Baker & Wurgler, 2006, 2007; Barberis et al., 1998; Brown & Cliff, 2005; Cohen & Kudryavtsev, 2012; Dhaoui & Bacha, 2017; Kumar & Lee, 2006), which have come to establish and consolidate the field of behavioral finance.

In Brazil, the research in this area is still recent and remains in its infancy. The national literature has documented evidence on investor sentiment and its relationship with stock returns (Yoshinaga & Castro, 2012), anomalies (Xavier & Machado, 2017), risk and return (Piccoli et al., 2018), earnings management (Santana et al., 2020), and the disposition effect (Lucchesi et al., 2015; Prates et al., 2019), but it is not yet clear what affects Brazilian investor sentiment. According to Yoshinaga and Castro (2012), more recent studies try to provide more explanations for the influence of sentiment on financial markets. However, these studies

have ignored the fact that the stock market's reaction to investor sentiment is preceded by the impact of economic uncertainty and monetary policy on such sentiment. According to some authors (Cohen & Kudryavtsev, 2012; Kurov, 2010; Menkhoff & Rebitzky, 2008; Silvia & Iqbal, 2011; Vuchelen, 2004; Zhang, 2019), economic uncertainties and monetary shocks are transmitted to the stock market via investors' reactions to economic and monetary news, as this directly affects the risk of stocks and the investor's risk aversion. This context reinforces the need for new studies that seek to explain Brazilian investor sentiment.

Considering this theoretical gap, this research aims to analyze the relationship between the main mechanisms of transmission of economic uncertainty and of monetary policy and investor sentiment in Brazil. Although these relationships can be determined by regression models or even causality and cointegration models, it is known that monetary policy has a short- and long-term relationship with confidence (Silvia & Iqbal, 2011). Because of this, an autoregressive distributed lag (ARDL) model was estimated, enabling short- and long-term estimates to be obtained among the variables. By considering the effects in different time horizons, a wider understanding of this relationship is obtained. Given the above, investor sentiment is expected to be affected by economic uncertainties and by monetary policy in the short and long terms. The results documented in this research are consistent and robust in relation to this prediction. The short- and long-term estimates derived from the ARDL model suggest that investor sentiment is affected by these variables to different extents, in the different time horizons.

The results documented in this research contribute in the following ways: (i) they broaden the literature and help in the theoretical understanding of the effects of economic uncertainty and of monetary policy over investor sentiment, a phenomenon that has until now been underexplored in Brazil; (ii) with relation to the previous studies, as well as corroborating their assumptions, they provide a methodological improvement in the estimates made by using an econometric model capable of capturing short- and long-term relationships. This control is important, given that monetary policies have a short- and long-term relationship with confidence (Silvia & Iqbal, 2011); (iii) in general terms, investors should consider economic uncertainty and monetary policy as a signal for altering their investment portfolio, not only as they affect

the return on their investments, but also because they affect the accounting dynamics and financial constraints of firms, which can impact the stock market. By considering sentiment as a useful indicator for anticipating economic trends (Vuchelen, 2004), policymakers and monetary

authorities can take different measures in response to the different changes in this indicator; and (iv) they provide support for focusing on economic and monetary policy in the National Financial Education Strategy (*ENEF*) (Decree n. 10,393, of June 9<sup>th</sup> of 2020) recently adopted in Brazil.

## 2. LITERATURE REVIEW

Considering the phenomena not totally explained by modern finance theory, in a seminal paper, Kahneman and Tversky (1979) elaborated prospect theory, which is considered to be a modern alternative for understanding some behaviors of the financial market. By considering the presence of emotions in financial decisions, this theory seeks to clarify and understand individuals' decision making in relation to risk. The work of Kahneman and Tversky (1979) preceded extensive literature that documented the influence of emotional biases on decision making (Baker & Wurgler, 2006, 2007; Barberis et al., 1998; Daniel et al., 1998; Dhaoui & Bacha, 2017; Kumar & Lee, 2006; Lee et al., 1991). These studies reveal that investor sentiment is influenced by heuristics, cognitive biases, and emotions associated with receiving and interpreting the information released in the market every day. These factors are especially strong when the available information is limited (Forgas, 1995), when the individuals have little experience (Ottati & Isbell, 1996) and low processing capacity (Greifeneder & Bless, 2007), or even when there is interference from the mass media (DellaVigna & Pollet, 2009), which can lead them to make wrong financial decisions.

The field of behavioral finance has progressed significantly, seeking to understand investor sentiment and the ways of measuring it. Some market measures include liquidity (Baker & Wurgler, 2006), dividend premiums (Baker & Wurgler, 2004), the number of initial public offerings (IPOs) and their mean return on the first day of trading (Baker & Wurgler, 2006; Ritter & Welch, 2002), and the discount on closed-end funds (Lee et al., 1991). There are also sentiment indices, such as those created by Baker and Wurgler (2006, 2007) and Brown and Cliff (2005), and opinion polls, such as confidence indices (Fernandes et al., 2013; Piccoli et al., 2018). In general, these studies do not provide a consensus on which proxy is most suitable. What is verified is that all appear to be well accepted by the scientific community. As highlighted by Baker and Wurgler (2006), there are no undisputed or definitive investor sentiment measures.

However, understanding investor sentiment goes beyond the ways of measuring it. As previously mentioned, sentiment is influenced by various factors, and some may be derived from the mechanisms of transmission of economic uncertainty and of monetary policy. Among the most recent theoretical developments in this important line of literature are the contributions from Kurov (2010), Silvia and Iqbal (2011), and Vuchelen (2004). With relation to the former, the main implication is that sentiment is sensitive to changes in expected earnings and to economic uncertainties, and that major changes, especially falls in sentiment, signal falls in economic growth. Kurov (2010) shows that the investor's psychology influences the stock market's reaction to monetary policies. For the author, investor sentiment is an important mechanism of transmission of the effects of monetary policy to stock returns. In the latter, Silvia and Iqbal (2011) provide a theoretical structure that highlights the role of confidence in business cycles, as well as the effect of monetary and fiscal policy on confidence.

Other recent related studies include those of Cohen and Kudryavtsev (2012), Menkhoff and Rebitzky (2008), and Zhang (2019). The first indicates that investor sentiment is strongly related with the exchange rate, especially in the long run. The second indicates, based on experimental evidence, that investors consider changes in the interest rate and inflation in their financial decisions. Zhang (2019) highlights that economic uncertainty also affects investor sentiment as it impacts the investment options and financial constraints of firms, in both cases affecting the investor's psychology and leading to repercussions in the stock market. Therefore, based on the previously theoretical implications developed (Kurov, 2010; Silvia & Iqbal, 2011; Vuchelen, 2004) and on the empirical and experimental evidence already documented (Cohen & Kudryavtsev, 2012; Menkhoff & Rebitzky, 2008; Zhang, 2019), the interest rate, the exchange rate, inflation, and economic uncertainty appear to be variables that have a potential impact on investor sentiment.

Inflation directly affects people's standard of living, so individuals give considerable weight to experiences of inflation when consumption, economics, and investment is concerned (Shiller, 1997). Many studies indicate that underlying expectations of inflation are shaped by previous experiences of inflation (Malmendier & Nagel, 2016; Marcet & Nicolini, 2003). The period of hyperinflation that occurred in Brazil in the 1980s and 1990s meant that individuals had to adapt in advance to the rapid and continuous general increase in prices, and so inflation expectations affect the way Brazilians interact with money and make financial decisions (Fajardo & Dantas, 2018). Investment decisions are particularly affected, as the returns on assets in the financial market tend to be negatively affected by inflation. In Brazil, a 1 percentage point increase in inflation has already been associated with a 0.57 percentage point drop in the real return on the Bovespa Index (Ibovespa) (Chaves & Silva, 2018). Within this context, an increase in inflation leads to an unfavorable economic climate and an increase in financial speculation, meaning investors become pessimistic and lose interest in investing their capital in various investment modalities, as their returns can decrease together with their purchasing power.

Expectations regarding changes in interest rates affect a wide variety of decisions, ranging from consumers' small daily expenses to investment decisions, which in turn affect the economic structure of a country (Omar, 2008). An increase in the interest rate is negatively associated with the proportion of capital that investors use to invest in stocks and corporate bonds. This occurs because the interest rate is a reference for the payment of remuneration on fixed income investments; that is, the higher the interest rate is, the more attractive fixed income investments become and the less attractive investments in the stock market are (Cohen & Kudryavtsev, 2012). The relationship between the interest rate and the stock market is not direct, as the return on these investments largely depends on the performance of companies. However, an increase in the interest rate negatively affects investment and consumption (Omar, 2008), and can thus affect the performance of companies and the price of their stocks. In Brazil, an unexpected positive variation of 1% in the interest rate has already been associated with a negative variation of 3.28% in the Ibovespa (Oliveira & Costa, 2013). As a result, there is a decrease in consumption and investment, meaning sentiment deteriorates.

The exchange rate is one of the factors that is most discussed by investors, as an increase tends to raise expectations of pessimism and risk aversion (Heiden et al., 2013; Menkhoff & Rebitzky, 2008), thus having a major

influence on their investment decisions. The exchange rate affects the performance of firms and stock market returns. According to Serafini and Sheng (2011), the exchange rate affects firms in different ways. For importers, it raises the price of inputs and products, reducing their margin and negatively affecting the price of their stocks. In contrast, firms that export may widen their margins if they receive a more highly valued currency, which can raise the performance of their stocks. When the foreign currency stops rising and becomes stable, the situation changes and importing companies improve their results. As inflation falls, with the dollar companies present better overall performance in the stock market. Given this scenario, investors tend to resize their investments in periods with a considerable rise in the exchange rate, defensively seeking to allocate their capital in firms where there is a high return in dollars, or even allocating their capital abroad, thus affecting their sentiment.

Economic uncertainty is also crucial for investors. According to Zhang (2019), investors' sentiment is the channel by which economic uncertainty is transferred to asset prices. This transmission phenomenon can be explained by real options theory (ROT) (Bernanke, 1983a, 1983b) and by factors related to firms' financial constraints. ROT is a method of analyzing real investments that enables the investor to value the various options in any investment project, such as delaying, reducing, abandoning, or altering the project (Trigeorgis, 1996). The ability to delay an investment is valuable, as the investor can wait for uncertainty to decrease before deciding to make an irreversible investment in order to avoid unfavorable results. Thus, the greater the economic uncertainty, the more unpredictable the expected future cash flows of an investment become, and the more likely investors are to delay their projects (Bulan et al., 2009; Tran, 2014), causing negative investor sentiment (Zhang, 2019).

Emotional expectations are also strong enough to affect investment decisions in firms through their impact on management expectations. These biases are particularly strong in periods of crisis and economic uncertainty, in which economic forecasts become harder (Ben-David et al., 2010; Chhaochharia et al., 2019) and the problems caused by asymmetric information about firms' projects worsen (Akerlof, 1970; Stiglitz, 1989). In periods of economic uncertainty, when confidence is lower, firms face greater external financing pressures (Zhang, 2019) and they may see an increase in the cost of such financing (McLean & Zhao, 2014). According to Zhang (2019), this type of environment exacerbates financial constraints through financial attrition, reducing

the allocation of capital. In other words, when economic uncertainty increases, the operational risk of companies also increases, and due to the specificity of assets, there is strong irreversibility in company investment. Faced with this environment, firms will try to delay or reduce their investment to maintain good operations. Also according to the author, these factors, besides inhibiting corporate investment, tend to inhibit the proportion of investor capital, resulting in negative sentiment.

These studies have revealed that Brazilian investor sentiment is potentially affected by economic uncertainty and by monetary policy and, therefore, can in fact be a mechanism of transmission of these variables to the stock market. The Brazilian market is undeniably affected by investor sentiment. Yoshinaga and Castro (2012) discovered a significant and negative relationship between sentiment and future rates of return, indicating the existence of a pattern of reversal in stock returns. Xavier and Machado (2017) found important evidence

that sentiment has a potential impact on value anomalies in the Brazilian market, and Piccoli et al. (2018) highlight that the risk-return relationship in the Brazilian market is positive (negative) in periods of low (high) sentiment and that the deterioration in this relationship is a result of the strong growth in the number of less sophisticated investors.

In addition, behavioral biases are highly pronounced in individual investors (Prates et al., 2019) and in equity fund managers (Lucchesi et al., 2015), who are strongly prone to the disposition effect, unlike institutional investors, whose behavior is inconsistent with this effect (Prates et al., 2019). Finally, some evidence indicates that investor sentiment also affects earnings management and, therefore, firm-level decisions. This occurs as accounting choices are much more than financial decisions and are subject to psychological biases (Santana et al., 2020). These characteristics imply the need for a greater understanding of the factors that affect Brazilian investor sentiment.

### 3. DATA AND METHODS

To carry out the research, four variables were used that represent the main and most reported mechanisms of transmission of economic uncertainty and of monetary policy, along with one representing investor sentiment. Due to the absence of data on investors' sentiment and emotions, unlike in other countries, the consumer

confidence index (CCI) was considered as a proxy for sentiment, as in previous studies (Fernandes et al., 2013; Zhang, 2019), including Brazil (Piccoli et al., 2018). A description of each one of the variables can be found in Table 1.

**Table 1**

*Description of the variables*

Variable	Proxy used	Description	Unit of measure	Source
Investor sentiment	CCI	Measures the consumer's sentiment in relation to the general economic situation and their personal finances	Index	FGV
Inflation rate	IPCA	Official inflation rate in Brazil	monthly %	Ipea
Exchange rate	Dollar	Mean commercial R\$/US\$ exchange rate (purchase value) for the period calculated based on daily purchase quotations	R\$	Ipea
Interest rate	SELIC	Basic interest rate of the economy	monthly %	Ipea
Economic uncertainty	IIE-Br	Measures the uncertainty in the Brazilian economy based on information from the main newspapers in the country, the Ibovespa, and financial market expectations regarding macroeconomic variables	Index	FGV

**Note:** The consumer confidence index (CCI) and the uncertainty index of the Brazilian economy (IIE-Br) are available at <https://portalibre.fgv.br>, in the section Fundação Getúlio Vargas (FGV) Dados, and the national consumer price index (IPCA), the Selic (exchange rate), and the exchange rate are available at <http://www.ipeadata.gov.br>.

Ibovespa = Bovespa Index; Ipea = Instituto de Pesquisa Econômica Aplicada (Institute of Applied Economic Research); monthly % = Percent per month.

**Source:** Elaborated by the authors.

The variables used have a monthly frequency and cover the period from January of 2006 to March of 2020, totaling 171 observations.

### 3.1 Estimation Strategy

To investigate the relationship between the variables, this study uses the ARDL modeling developed by Pesaran and Shin (1999) and Pesaran et al. (2001). This approach has advantages in relation to other cointegration tests and vector autoregressive models. One advantage is that the method can be applied in variables with different orders of intergration ( $I(0)$  or  $I(1)$ ), but no variable can be  $I(2)$ . The method is also more efficient for capturing long-term relationships in small samples. In addition, an optimal level of lags can be determined for each one of the variables of the model (Pesaran & Shin, 1999); when done adequately, it tends to correct possible serial correlation and endogenous regressor problems. Specifically in the latter case, Pesaran and Shin (1999) show that the potential endogeneity of  $I(1)$  regressors can be addressed with an appropriate increase in the number of maximum lags considered at the time of the estimation.

Prior to estimating the ARDL model, it is important to ensure that the variables used are not second-order integrated ( $I(2)$ ). This is done by applying the traditional unit root tests. After this stage, the length of the ideal lag of each variable should be defined, in this case determined using the Akaike information criterion (AIC) (Akaike, 1973). The ARDL procedure starts with the significance test of the lagged values of the variables in the form of an error correction of the ARDL model using the F statistic. To avoid the problem associated with the non-standardized nature of the asymptotic distribution, the F statistic is calculated independently of the regressors being  $I(0)$  or  $I(1)$ . The null hypothesis ( $H_0$ ) states that if the F statistic calculated is below the critical values,  $H_0$  is not rejected; that is, there is no cointegration. However, if the F statistic is higher than the upper band of critical values,  $H_0$  is rejected, suggesting the existence of cointegration and a long-term relationship between the variables. Finally, if the F statistic is within the interval of critical values, the results are inconclusive. The ARDL model of conditional correlation of errors to be estimated is the following:

$$\Delta \text{SENT}_t = \alpha_0 + \sum_{j=1}^p \phi_j \Delta \text{EXC}_{t-j} + \sum_{j=0}^p \theta_j \Delta \text{INF}_{t-j} + \sum_{j=0}^p \lambda_j \Delta \text{EU}_{t-j} + \sum_{j=0}^p \omega_j \Delta \text{INT}_{t-j} + \delta_j \text{EXC}_{t-j} + \delta_j \text{INF}_{t-j} + \delta_j \text{EU}_{t-j} + \delta_j \text{INT}_{t-j} + \mu_t \quad 1$$

in which SENT is investor sentiment, EXC is the exchange rate, INF is the inflation rate, EU is economic uncertainty, INT is the interest rate,  $\Delta$  is the first difference operator, and  $p$  is the ideal lag size. The hypothesis tested in this phase using the F statistic is that there is no long-term

relationship ( $H_0$ ), compared to the alternative hypothesis that there is a long-term relationship ( $H_1$ ). Given the presence of a long-term relationship, the next stage is to estimate the long-term coefficients:

$$\text{SENT}_t = \alpha_1 + \sum_{j=1}^p \phi_1 \text{EXC}_{t-j} + \sum_{j=0}^p \theta_1 \text{INF}_{t-j} + \sum_{j=0}^p \lambda_1 \text{EU}_{t-j} + \sum_{j=0}^p \omega_1 \text{INT}_{t-j} + \mu_t \quad 2$$

Subsequently, the coefficients of the short-term dynamic derived from the error correction are estimated:

$$\text{SENT}_t = \alpha_2 + \sum_{j=1}^p \phi_2 \Delta \text{EXC}_{t-j} + \sum_{j=0}^p \theta_2 \Delta \text{INF}_{t-j} + \sum_{j=0}^p \lambda_2 \Delta \text{EU}_{t-j} + \sum_{j=0}^p \omega_2 \Delta \text{INT}_{t-j} + \sigma \text{ECM}_{t-1} + \mu_t \quad 3$$

in which  $\text{ECM}_{t-1}$  is the velocity of adjustment parameter and shows how much of the disequilibrium is being corrected in the long run; that is, it shows how the errors generated in one period are corrected in the subsequent period. A

negative coefficient below 1 is expected, as a negative coefficient indicates convergence, while a positive value represents an explosive and unreasonable convergence process. The error correction term can be defined as:

$$\text{ECM}_t = \text{SENT}_t - \left[ \alpha_1 + \sum_{j=1}^p \phi_1 \text{EXC}_{t-j} + \sum_{j=0}^p \theta_1 \text{INF}_{t-j} + \sum_{j=0}^p \lambda_1 \text{EU}_{t-j} + \sum_{j=0}^p \omega_1 \text{INT}_{t-j} \right] \quad 4$$

After the estimates, some diagnostic tests should be conducted, such as those of normality, serial correlation, heteroscedasticity, and adequacy of the specified functional

formula. In addition, the stability of the coefficients of the models should be verified, via the cumulative sum (CUSUM) and the cumulative sum of squares

(CUSUMSQ) (Brown et al., 1975). The parameters are found to be unstable if the tests exceed the area between the 5% critical bands, indicating the influence of structural breaks in the estimation. These tests are particularly

necessary in series that show the potential existence of structural breaks in their trajectory. As the time period analyzed includes crises, these tests are particularly needed to guarantee the reliability of the model.

## 4. EMPIRICAL RESULTS AND DISCUSSION

Table 2 shows the descriptive statistics of the variables included in the model. The variables related to monetary policy have a very close mean and standard deviation, as occurs between sentiment and uncertainty. The statistics related to the kurtosis do not have high values, with the

exception of the exchange rate, which has a flatter and therefore leptokurtic distribution. Asymmetry also does not show excessive values, although all the variables lean slightly to the left or to the right of the mean.

**Table 2**

*Descriptive statistics (period from January of 2006 to March of 2020, monthly data)*

Descriptive statistics	SENT	EXC	INF	EU	INT
Mean	4.567	0.893	0.447	4.643	0.829
Median	4.596	0.797	0.430	4.624	0.840
Minimum	4.175	0.444	0.010	4.443	0.290
Maximum	4.797	1.585	1.320	5.118	1.430
Standard deviation	0.123	0.310	0.273	0.110	0.230
Asymmetry	-1.238	0.392	0.868	0.736	-0.059
Kurtosis	1.305	-1.251	0.806	0.790	-0.591

**Note:** The variables are in natural logarithms, with the exception of INT and INF, which were already in percentage variation. The statistics are based on 171 observations.

**Source:** Elaborated by the authors.

Subsequently, the order of integration of the series was verified to guarantee that none of the variables is  $I(2)$ , as the ARDL is based on the condition that the variables are  $I(0)$  or  $I(1)$  or mutually cointegrated. For this purpose, the augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1981) and Phillips-Perron (PP) test (Phillips & Perron,

1988) were used. The ADF and PP tests are based on  $H_0$ , that is, the series is not stationary and integrated in the order  $d$  ( $d > 0$ ),  $I(1)$ , or  $I(2)$ , as opposed to  $H_1$ , which assumes stationarity ( $I(0)$ ). Table 3 shows the results of the tests.

**Table 3**

*Results of the augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests for in level and first difference variables (period from January of 2006 to March of 2020, monthly data)*

	ADF (t-stat)		PP (t-stat)	
	In level	First difference	In level	First difference
SENT	-1.173	-13.049	-1.145	-13.059
EXC	-1.571	-20.682	-0.939	-21.228
INF	-8.349	-	-8.365	-
EU	-2.289	-9.340	-2.289	-11.806
INT	-2.252	-23.814	-1.591	-21.775

**Note:** The variables are in natural logarithms, with the exception of INT and INF, which were already in percentage variation. The appropriate lag lengths in the ADF tests are selected using the Akaike information criterion. To calculate the widths of the bands for the PP test, the Andrew procedure was used. The tests are based on 171 observations. The critical in level values are: ADF 5%,  $t\text{-calc.} = -2,885$ ,  $H_0 = I(1)$  non-stationary,  $H_1 = I(0)$  stationary; PP 5%,  $t\text{-calc.} = -2,878$ ,  $H_0 = I(1)$  non-stationary,  $H_1 = I(0)$  stationary.

**Source:** Elaborated by the authors.

The results of the ADF test show that investor sentiment, the interest rate, the exchange rate, and economic uncertainty are stationary after the first difference, while the inflation rate is stationary in level. The PP test provides similar results to the ADF test. Therefore, both indicate the presence of  $I(0)$  and  $I(1)$  variables, thus justifying the use of the ARDL model. After this stage, it is necessary

to adjust a model with an ideal number of lags for each variable. Considering the maximum order of lags  $p = 4$ , the ARDL model that minimizes the AIC is (4, 1, 3, 0, 4). After verifying the absence of  $I(2)$  variables and determining the ideal model, the existence of a long-term relationship between the variables was tested using the ARDL bounds test, and the results are presented in Table 4.

**Table 4***ARDL bounds test*

Statistical test	Value	Level of significance (%)	Critical value limits	
			$I(0)$	$I(1)$
F-statistic	8.285	1	3.290	4.370
		5	2.560	3.490
		10	2.200	3.090

**Note:** Null hypothesis (there is no long-term relationship).

**Source:** Elaborated by the authors.

The F statistic calculated (8.285) is higher than the critical value of the upper limit by 10, 5, and 1%. Based on that result,  $H_0$  of the test is rejected and it is concluded that the mechanisms of transmission of economic uncertainty and of monetary policy affect investor sentiment in the long run. From this, the long-term (equation 2) and short-term coefficients are estimated using an error correction

model (equation 3). In the latter, besides the short-term impacts, the velocity of adjustment parameter is obtained [error correction model ( $ECM_{1,1}$ )], which indicates how much the disequilibrium is being corrected in the long run; that is, how the errors generated in one period are corrected in subsequent periods. Table 5 shows the short- and long-term relationships.

**Table 5***Short- and long-term estimates and diagnostic and stability tests for the autoregressive distributed lag (ARDL) model (4, 1, 3, 0, 4)*

Panel A		Long-term effects		
	Coefficient	Standard error	t statistic	p-value
<b>Dependent variable: Sent</b>				
EXC	-0.139	0.042	-3.280	0.001
INF	-0.273	0.054	-5.040	0.000
EU	-0.440	0.125	-3.547	0.000
INT	-0.244	0.047	-5.184	0.000
Constant	7.081	0.550	12.872	0.000
Panel B		Short-term effects		
<b>Dependent variable: <math>\Delta</math>Sent</b>				
$\Delta(\text{SENT})_{-1}$	0.038	0.068	0.559	0.576
$\Delta(\text{SENT})_{-2}$	0.200	0.069	2.890	0.004
$\Delta(\text{SENT})_{-3}$	0.103	0.068	1.496	0.136
$\Delta(\text{EXC})$	-0.301	0.074	-4.034	0.000
$\Delta(\text{INF})$	-0.033	0.012	-2.701	0.007
$\Delta(\text{INF})_{-1}$	0.034	0.013	2.534	0.012
$\Delta(\text{INF})_{-2}$	0.026	0.012	2.084	0.038
$\Delta(\text{INT})$	-0.110	0.042	-2.600	0.010
$\Delta(\text{INT})_{-1}$	-0.098	0.045	-2.188	0.030
$\Delta(\text{INT})_{-2}$	0.051	0.045	1.117	0.265
$\Delta(\text{INT})_{-3}$	0.094	0.040	2.318	0.021
$ECM_{-1}$	-0.304	0.042	-7.167	0.000



**Table 5**

Cont.

Statistical summary	Statistic	p-value
R <sup>2</sup>	0.381	-
Adjusted R <sup>2</sup>	0.337	-
Breusch-Godfrey serial correlation test ( $\chi^2$ )	0.473	0.789
Breusch-Pagan-Godfrey heteroscedasticity test ( $\chi^2$ )	11.459	0.780
Jarque-Bera normality test	0.152	0.926
Ramsey RESET test $F_{1,71}$	0.107	0.947

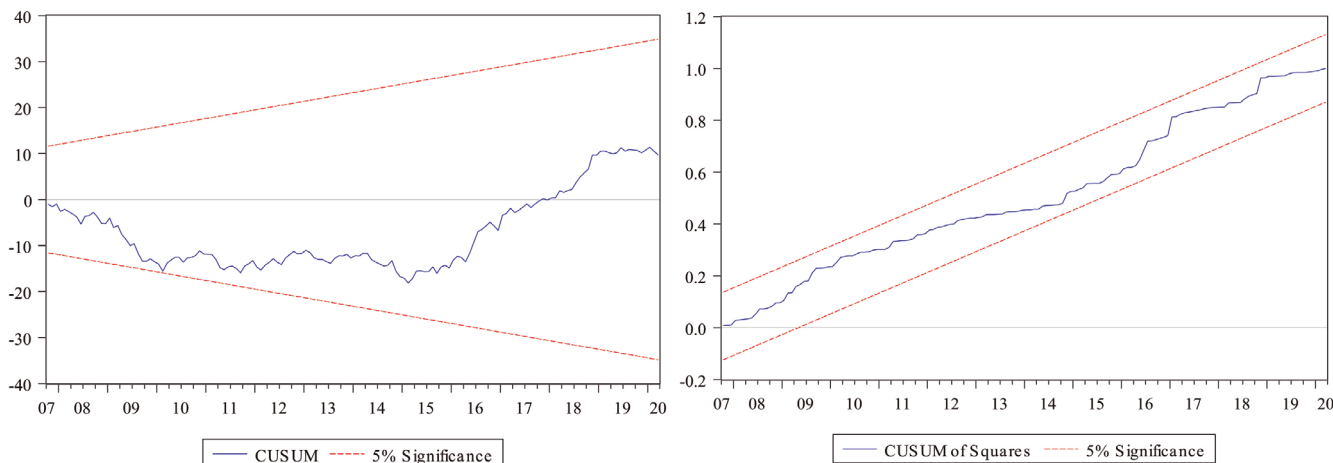
**Note:** The error correction model ( $ECM_{t-1}$ ) coefficient (-0.304) is obtained using equation 4 and indicates that around 30.40% of the errors generated in each period are corrected in subsequent periods (or in the following months). The error correction equation is:  $EC = SENT - (-0.444 * IE) - 0.139 * EXC - 0.273 * INF - 0.244 * INT + 7.082$ .

$\Delta$  = first difference of the respective variable.

**Source:** Elaborated by the authors.

The results presented in the statistical summary (see Table 5) support the validity of the estimated model. The Breusch-Godfrey Lagrange multiplier (LM) test does not reject  $H_0$  regarding the absence of an autocorrelation. The Breusch-Pagan-Godfrey LM does not reject  $H_0$  regarding the absence of heteroscedasticity. The Jarque-Bera test indicates normality of the residuals and the Ramsey regression equation specification error test (RESET)

does not reject  $H_0$  in terms of the polynomial terms not contributing to the model adjustment; therefore, there was no specification error in the regression equation. Finally, the stability of the coefficients of the model was verified using the CUSUM and CUSUMSQ tests, which enable the constancy of the parameters in a model to be observed. The results are illustrated in Figure 1.



**Figure 1** Results of the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests

**Note:** The two dotted lines correspond to the critical limits of the tests at a 5% level of significance.

**Source:** Elaborated by the authors.

Figure 1 suggests that  $H_0$ , which assumes that the coefficients of the model are stable, cannot be rejected at a 5% level of significance for the CUSUM and CUSUMSQ tests, as the cumulative sum remains in the 95% confidence interval and the residual variation is stable, as the cumulative sum of squares is within a 5% significance level. This indicates that the model is not incorrectly specified and suggests the absence of abrupt structural alterations in the model over time. The stability reported

by the tests is particularly important, as various events occurred in the period analyzed, such as the international financial crisis and “Operation Car Wash” (“Operação Lava Jato”), whose impact on the variables could cause strong structural breaks that would compromise the validity of the model.

Based on the results of the estimated models, it is possible to observe that in the long run all the variables negatively affect investor sentiment at a 1% significance

level, indicating that these variables create bouts of low sentiment (pessimism) among investors. In the short run, all the variables, with the exception of economic uncertainty, affect investor sentiment. This result confirms that economic uncertainty and monetary policy maintain a short- and long-term relationship with sentiment, as previously highlighted by Silvia and Iqbal (2011). This result is, in itself, relevant. Unlike the optimistic investor, the pessimist tends to spend and invest less, so this indicator acts as a reductive or inductive factor of economic growth. According to Vuchelen (2004), big changes, especially falls in sentiment, signal falls in economic growth.

Based on the (short-term) error correction models, it is possible to observe that investor sentiment is affected by itself in ( $t_{-2}$ ), indicating an autoregressive characteristic of the series, as previously documented by Vuchelen (2004). In behavioral terms, this means that the sentiment at a given point in time ( $t$ ) is the result of a cumulative trajectory of emotional biases from ( $t_{-2}$ ) (months) prior. It also means that the current sentiment will have an effect on the investor's judgments and decision making for up to  $n$  periods (months) ahead.

Investor sentiment is affected by short- and long-term inflation, where the impact in the long run is almost seven times greater than the impact in any short-term period. This relationship can be explained by the strong influence of inflation on people's standard of living (Shiller, 1997). Brazilians tend to alter the way they interact with money and make financial decisions, due to their past experiences with hyperinflation (Fajardo & Dantas, 2018). This characteristic may also explain the large magnitude of the long-term relationship, as underlying expectations for inflation can be shaped by previous impressionable experiences, such as hyperinflation, and for that reason they tend to persist in the long run (Fajardo & Dantas, 2018; Malmendier & Nagel, 2016; Marcet & Nicolini, 2003). In addition, the return on financial market assets tends to be negatively impacted by inflation (Chaves & Silva, 2018), meaning investment decisions are heavily affected. These circumstances raise the pessimism of investors, who tend to reduce their interest in investing their capital in the various investment modalities.

The interest rate affects investor sentiment in a similar way to inflation. In the short run, it affects it for up to four periods, the first two negatively. In the long run, its negative affect is greater than in any short-term period. The existence of this relationship is consistent with the theoretical expectations. According to Omar (2008), interest rate changes affect a wide variety of consumption and investment decisions; an increase, for example, can negatively affect the performance of

companies and, consequently, the price of their stocks. In Brazil, an unexpected positive variation of 1% in the interest rate has already been associated with a negative variation of 3.28% in the Ibovespa (Oliveira & Costa, 2013). Moreover, an increase in the interest rate tends to be negatively associated with investor sentiment, as the interest rate is a reference for the payment of remuneration on fixed income investments, and the higher the interest rate, the more attractive these investments are and the less attractive the stock market tends to be (Cohen & Kudryavtsev, 2012). These circumstances tend to lead investors to diversify their portfolios and to seek better returns whenever interest rates change. As a result, there is a reduction in consumption and in investment, meaning that investors' expectations deteriorate.

Investor sentiment is also sensitive to changes in the exchange rate, but unlike the inflation and interest rates, the negative short-term impacts are greater than the negative long-term impacts. Although to different extents, the negative relationship is in line with previous studies (Heiden et al., 2013; Menkhoff & Rebitzky, 2008), indicating that the exchange rate leads to a reduction in investor sentiment. One possible explanation may be related to the rapid transmission of an increase in value of the foreign currency to consumer goods, as well as the effect on the performance of firms and the stock market. According to Serafini and Sheng (2011), the changes caused by the exchange rate mean that investors have to resize their investments in periods of wide variations in the exchange rate, defensively seeking to allocate their capital in firms where there is a high return in dollars, or even allocating their capital abroad.

Economic uncertainty negatively affects investor sentiment and only in the long run. This relationship can be explained by ROT and by questions related to firms' financial constraints (Zhang, 2019). From the ROT perspective (Bernanke, 1983a, 1983b), when the economy is uncertain and volatile, the expected future cash flows of an investment become more unpredictable and, for that reason, investors tend to delay their projects (especially irreversible ones) in order to avoid losses (Bernanke, 1983; Bulan et al., 2009; Tran, 2014; Trigeorgis, 1996; Zhang, 2019).

An uncertain environment also affects the financial dynamic of firms. In these periods, it is harder for company managers to predict economic conditions due to the rise in information asymmetry in the market (Akerlof, 1970; Stiglitz, 1989), which causes biased expectations regarding management decisions (Chhaochharia et al., 2019). There is also a greater probability of financial directors showing psychological biases in their decisions (Ben-David et al., 2013). In addition, in periods of uncertainty, financial

institutions tend to be wary of granting credit, raising the cost of external financing (McLean & Zhao, 2014) and reducing investment as a whole. In Brazil, the recent crisis in 2015 negatively impacted company investments and this impact was greater over financially constrained companies (Franzotti & Valle, 2020). This type of environment worsens financial constraints through financial attrition, reducing the allocation of capital. Inefficient allocation of capital can lead to an overestimation or underestimation of capital. When capital is mistakenly assessed, investor sentiment and behavior will be influenced, causing negative repercussions in the market (Zhang, 2019).

In general, the long-term impacts are greater for the interest and inflation rates, as well as economic uncertainty, which only affects sentiment in this way. The impact of the

variables over sentiment in different time horizons may be related to the fact that investors have limited information (Forgas, 1995), little experience (Ottati & Isbell, 1996), or low processing capacity (Greifeneder & Bless, 2007), which can mean that these impacts affect sentiment gradually in the short and long terms. Another possibility is related to investor inattention and distraction. According to Vuchelen (2004), the economic uncertainty experienced by analysts is transmitted to consumers and investors, especially when the mass media tends to highlight and reinforce the divergences between future predictions. This latter case tends to have a self-reinforcing effect, as information is incorporated into prices quicker when it receives greater coverage in the media (DellaVigna & Pollet, 2009).

## 5. CONCLUDING REMARKS

In this article, it was verified how the main and most reported mechanisms of transmission of economic uncertainty and of monetary policy affect investor sentiment. Based on an autoregressive distributed lag model, it was found that investors are sensitive to these mechanisms in different ways in the short and long terms. This result is consistent with the theoretical developments (Kurov, 2010; Silvia & Iqbal, 2011; Vuchelen, 2004) and with recent empirical and experimental research (Cohen & Kudryavtsev, 2012; Menkhoff & Rebitzky, 2008; Zhang, 2019). Understanding this relationship is hugely desirable in Brazil, whose stock market is undeniably affected by investor sentiment (Lucchesi et al., 2015; Piccoli et al., 2018; Prates et al., 2019; Santana et al., 2020; Xavier & Machado, 2017; Yoshinaga & Castro, 2012).

Monetary policy has two major objectives: price stability and sustainable economic growth. However, these objectives can only be achieved through the effects of monetary policy in the financial markets, including the stock markets (Kurov, 2010). In addition, uncertainty shocks can generate negative impacts both on companies, discouraging investments and production, and on families, reducing the tendency for consumption. Based on the results obtained, monitoring investor sentiment in relation to the market can signal its financial decisions, thus constituting a useful indicator for anticipating the course of the Brazilian economy.

Based on the relationships found, policymakers, governments, and monetary authorities can use these mechanisms to develop policies that aim to restore sentiment. This can be particularly important in periods of recession, collapse, or crisis, as high levels of sentiment

can signal economic recovery. Investors should consider economic uncertainty and monetary policy as a signal for altering their investment portfolio, not only as it impacts the return on their investments, but also because it affects the accounting dynamic and financial constraints of firms, which can have repercussions in the stock market.

Even though only a small portion of the Brazilian population does in fact invest, the circulation of economic and monetary information has a determining impact on the general understanding of its resulting effects. For this reason, the ENEF (Decree n. 10,393, of June of 2020) could mobilize actions that raise people's understanding of monetary policy and its economic effects, thus raising their informational framework for financial decision making. These actions could also contribute to minimizing the distraction and inattention of investors in relation to the economic uncertainty experienced by analysts and transmitted by the mass media (DellaVigna & Pollet, 2009).

Although the results obtained are theoretically consistent and practically orientated, this research has some limitations, essentially linked to the choice of proxy for investor sentiment. Future studies could explore/create other measures of sentiment. Another limitation is derived from the variables used to represent monetary policy. Although the variables used are the ones most reported by the behavioral literature, these may represent wider economic conditions and, for that reason, future studies could explore monetary policy in more depth together with other macroeconomic variables. This would be useful both to validate the results presented here and to better understand the effects of general economic behavior over investor sentiment. It is also important to highlight

that the scarcity of studies in this line of literature may limit the theoretical interpretation of the relationships found. However, this is still an initial study and so there is a promising field to be explored. Besides the use of

secondary data, the experimental approaches can make a valuable contribution as they broaden the range of variables that can be considered as determinants for understanding this relationship.

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