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ORIGINAL ARTICLE

Economic policy uncertainty, sentiment and Brazilian stock market performance

Wanderci Alves Bitencourt[1]
https://orcid.org/0000-0002-9509-7786
Email: comunicacao.reitoria@ifmg.edu.br

Robert Aldo Iquiapaza[2]
https://orcid.org/0000-0003-1657-2823
Email: rbali@ufmg.br

[1] Instituto Federal de Minas Gerais, Departamento de Gestão, Formiga, MG, Brazil
[2] Universidade Federal de Minas Gerais, Faculdade de Ciências Econômicas, Departamento de Ciências Administrativas, Belo Horizonte, MG, Brazil

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ABSTRACT

The aim of this article was to investigate the causal relationships between economic policy uncertainty, investor sentiment, and the performance of the Brazilian market, while taking into account the presence of asymmetries and both short- and long-term cointegration. In market dynamics, it is expected that economic policy uncertainty, investor sentiment, and market performance will show some degree of relationship. In the Brazilian context, the analysis of these three variables has not been carried out, especially considering their assymmetric interrelations and the behavior of the relationships in the short and long term simultaneously. Understanding these relationships is important because it allows agents to know the potential impacts that these variables have on each other, which will facilitate informed decision-making among the involved parties. The results obtained are relevant for investment strategies, as informed investors will direct their decisions towards minimizing their exposure to market fluctuation, based on identified causal relationships and anticipating potential market movements. Utilizing a nonlinear autoregressive distributed lag model, the study showed that the relationships between investor sentiment, economic policy uncertainty, and stock market performance are more complex than suggested by previous studies applied to the Brazilian market. We identified asymmetric short- and long-term relationships not previously observed.

Keywords: economic policy uncertainty, investor sentiment, market performance, asymmetric effects, NARDL.

Correspondence address

Wanderci Alves Bitencourt
Instituto Federal de Minas Gerais, Departamento de Gestão
Rua Padre Alberico, 440 – CEP: 35577-020
São Luiz – Formiga – MG – Brazil

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A incerteza da política econômica, sentimento e o desempenho do mercado de ações brasileiro

RESUMO

O objetivo deste artigo foi investigar as relações causais entre incerteza da política econômica, sentimento do investidor e desempenho do mercado brasileiro, levando em consideração a presença de assimetrias e cointegração de curto e longo prazo. Na dinâmica do mercado, espera-se que a incerteza da política econômica, o sentimento do investidor e o desempenho do mercado apresentem algum grau de relacionamento. No contexto brasileiro, a análise dessas três variáveis não foi realizada, especialmente considerando inter-relações assimétricas e o comportamento das relações no curto e longo prazo simultaneamente. Compreender essas relações é importante porque permite aos agentes conhecer os impactos potenciais que essas variáveis têm entre si, o que facilitará na tomada de decisão informada entre as partes envolvidas. Os resultados obtidos são relevantes para estratégias de investimento, uma vez que investidores informados direcionarão suas decisões para minimizar sua exposição à flutuação do mercado, com base nas relações causais identificadas e antecipando possíveis movimentos de mercado. Utilizando um modelo autorregressivo distribuído não linear, o estudo mostrou que as relações entre o sentimento do investidor, a incerteza da política econômica e o desempenho do mercado de ações são mais complexas do que sugerido por estudos anteriores aplicados ao mercado brasileiro. Identificamos relações assimétricas de curto e longo prazo não observadas anteriormente.

Palavras-chave: *incerteza da política econômica, sentimento do investidor, desempenho do mercado, efeitos assimétricos, NARDL.*

1. INTRODUCTION

A relevant question in finance is to understand which drivers can explain stock market returns. Research in this field has culminated in two strands of empirical investigation: one focused on risk factors and the other on macroeconomic and financial factors (Dahmene et al., 2021). These two strands have theoretical implications, as the ability to predict market movements depends on how predictable and interpretable the set of available information is.

In this context, investor sentiment reflects investors' perceptions of the market, becoming an important driver of decision-making and provider of relevant information about market dynamics (Nowzohour & Stracca, 2020; Marschner & Ceretta, 2021). Therefore, an increase in this sentiment indicates a higher level of pessimism.

Given that investor sentiment is influenced by the monitoring of news related to economic policy uncertainty (Baker, Bloom & Davis, 2016), it is reasonable to assume a relationship between sentiment, economic policy uncertainty, and the movements observed in stock markets, both in terms of prices and volatility (Franco, 2022).

The basis for this cycle of relationships lies in understanding how expectations are formed and their subsequent influence on the flow of investments. This dynamic, where investment activities expand and contract, reflect a sequence of decisions made in an uncertain environment. These decisions are based on the interpretation of a set of available information or, alternatively, on investors' feelings and beliefs about future asset prices and investment risk (Baker & Wurgler, 2007; Franco, 2022).

A comprehensive review of the literature on these relationships conducted by Al-Thaqeb and Algharabali (2019) found that many studies, especially after the 2008 financial crisis, began to examine the relationships between economic policy uncertainty, market performance, and investor sentiment. However, many of these studies assumed symmetric relationships between the variables, which can lead to an overly restrictive understanding of the relationships (Franses et al., 2000; Shin et al., 2014).

Another important factor to consider when studying these relationships is the characteristics of the market under analysis. Fluctuations in economic policy uncertainty, investor sentiment, and the stock market are strongly influenced by local factors (Rehman et al., 2021). In this sense, Brazil offers a favorable environment for this type of research. The country has shown higher than normal levels of uncertainty in recent years, resulting from a scenario of political and economic instability and fiscal crisis (Batista et al., 2023). In addition, it is a market with specific characteristics, such as liquidity, which may make the results of empirical studies applied to this economy different from those applied to others (Piccoli et al., 2018).

However, there are few published studies on this topic that investigate these relationships in the Brazilian market. Moreover, the existing ones only consider the relationships between specific pairs of variables, usually focusing on the relationship between investor sentiment and economic policy uncertainty (Yoshinaga & Castro, 2012; Piccoli et al., 2018; Marschner & Ceretta, 2021; Franco, 2022) or on the relationship between economic policy uncertainty and market performance in terms of returns or volatility (Gea et al., 2021; Ferreira et al., 2021). Furthermore, although most of these studies make assumptions to capture asymmetric relationships or assess the behavior of the relationships in the short and long run, no study was identified that simultaneously considers asymmetry and short- and long-term nonlinearities.

In light of the above, the aim of this paper is to contribute to this area of research by extending the studies that have been carried out by investigating the relationships between economic policy uncertainty, investor sentiment and stock market performance in the Brazilian context. To this end, the nonlinear autoregressive distributed lag (NARDL) model will be applied, specifically to capture asymmetries in the short- and long-term relationships, in line with recent applications by Liang et al. (2020) and Ugurlu-Yildirim et al. (2021).

This study contributes to the international and national literature in several ways. First, the importance of the nonlinearity of these relationships allows for a more precise and complete understanding between them, enabling a better understanding of financial market fluctuations in an emerging market that suffers from various types of instability and has a high level of uncertainty. Second, the use of the NARDL model makes it possible to capture the short- and long-term equilibrium adjustment patterns after positive and negative shocks, as well as to analyze the cointegration between the explanatory variables, which, to the authors' knowledge, has not been done in Brazil. Third, in addition to assessing the existence and forms of these relationships, it is also possible to assess whether the observed effects are transitory or persistent over time, which is a differential in the case of investment decisions.

2. THEORETICAL AND METHODOLOGICAL FRAMEWORK

2.1 Economic Policy Uncertainty, Sentiment and the Stock Market

The relationship between economic policy uncertainty, investor sentiment and stock market performance has attracted the interest of several studies in finance and economics. Uncertainty plays an important role in investment decisions because an increase in uncertainty can affect the economic system and market dynamics, leading to a possible postponement of spending and investment by companies and individuals (Garcia, 1999; Bloom, 2009; Liang et al., 2020, Franco, 2022; Batista et al., 2023), as well as an increase in risk aversion (Zhang, 2019; Dahmene et al., 2021).

When economic policy uncertainty is high, investor expectations become more uncertain (Ferreira et al., 2019), which can negatively affect investor sentiment and lead them to adopt a more conservative stance toward financial assets, which can result in a decline in market returns (Baker et al., 2016; Zhang, 2019; Rehman et al., 2021). In this context, an increase in risk aversion tends to signal an increase in volatility and a decline in returns (Dahmene et al., 2021).

It should be noted that this dynamic persists even in the face of the heterogeneity of agents in the market (Bali et al., 2017; Ferreira et al., 2021). According to Shiller (1981) and Baker and Wurgler (2007), economic policy uncertainty may be perceived by investors as an additional risk, leading them to demand a higher rate of return for investing in the stock market. On the other hand, a reduction in uncertainty can stimulate consumption growth in the short run due to pent-up demand (Bachman & Bayer, 2013).

Although the relationship between uncertainty, investor sentiment, and stock market performance is theoretically grounded, much remains to be understood about its meaning and intensity, as well as the factors that influence it (Baker & Wurgler, 2007). An important issue highlighted by Bali et al. (2017) is the distinction between risk and uncertainty. Investors are concerned not only with the probabilities associated with asset returns, but also with uncertainty about events that may affect the distribution of future returns. This distinction is inherent in finance theory, the most widely accepted concept of which is that proposed by Knight, where uncertainty is defined as decision situations in which information is very imprecise and probabilities are unknown (Garcia, 1999).

Measuring uncertainty is not a simple task, but there are proxies for uncertainty, such as the Economic Policy Uncertainty Index (EPU) proposed by Baker et al. (2016), and the Economic Uncertainty Index (IIE-Br) for the Brazilian market, developed by Ferreira et al. (2019). These indices capture the level of uncertainty, mainly based on the frequency of terms related to economic uncertainty in publications in newspapers, magazines and specific reports.

There are also several ways to measure investor sentiment. One of them is the FEARS index proposed by Zhi, Engelberg and Gao (2015), which uses textual data from the internet. The index of Baker, Wurgler and Yuan (2012) considers six variables: trading volume, putcall ratio, advance-decline ratio, market turnover, stock turnover, and the number of IPOs. Another widely used measure is the Implied Volatility Index (VIX), which reflects investors' expectations of future market volatility or, alternatively, as a proxy for market sentiment (Bloom, 2009). In the Brazilian context, Astorino et al. (2017) proposed the Implied Volatility Index (IVol), which is based on the VIX and incorporates adjustments that reflect the specific characteristics of the Brazilian market.

The lack of a direct measure for variables such as uncertainty and investor sentiment results in a variety of studies on the subject. These studies may differ in terms of the market studied, the time period analyzed, the methodology used, and the choice of proxies for the variables. Although all these measures aim to measure similar effects, their methodologies may differ, resulting in differences in the results between studies (Al-Thaqeb & Algharabali, 2019).

Many factors affect uncertainty, both in the short term and in the long term. Therefore, the time horizon is a key factor in understanding the impact of the determinants of uncertainty. This requires finding measures of the uncertainty caused by these various factors (Al-Thaqeb & Algharabali, 2019).

As shown in Table 1, no studies were identified that jointly analyze the causal relationships between sentiment, economic policy uncertainty and market performance for the Brazilian market. Two studies that make this assessment are those of Ugurlu-Yildirim et al. (2021) and Rehman et al. (2021), both of which considered the US market. The study by Ugurlu-Yildirim et al. (2021) used the NARDL model and found a bidirectional and negative relationship between the S&P500 and the EPU in the short run, and a positive and bidirectional relationship between stock prices and the Consumer Confidence Index (CCI) (a proxy for sentiment) in both the short and long run. The effect of the EPU on the CCI was negative and slightly asymmetric in the long run. In the short run, an increase in the CCI increases the UPE, while a decrease in the CCI has no significant impact on the EPU.

Table 1
Summary of the main empirical studies evaluating the relationship between sentiment, economic policy uncertainty and market performance in the Brazilian market

Relationships	Author	Period	Method	Contributions
Economic policy uncertainty and sentiment	Marschner & Ceretta (2021)	01/2006 to 03/2020	Autoregressive distributed lag model (ARDL)	It suggests differences in the influence of economic uncertainty (IIE-Br) and investor sentiment (CCI) in the short and long term.
	Franco (2022)	02/2002 to 12/2019	Linear parametric and nonlinear nonparametric causality tests	They report that the CCI acts as a transmission channel for uncertainty (EPU and IIE-Br) to the extent that it affects the formation of expectations.
Economic policy uncertainty and stock market performance	Phan et al. (2018)	Brazil: 01/1991 to 06/2016	Autoregressive model (AR)	They conclude that the EPU predicts excess stock returns in an asymmetric and country/sector specific manner. The study examined 16 countries, including Brazil. For the Brazilian market, no relationship was found between EPU and excess returns.
	Gea et al. (2021)	01/2000 to 05/2020	Generalized method of moments (GMM)	The EPU can be a good predictor of future stock market performance.
Investor sentiment, returns and/or stock market volatility	Yoshinaga & Castro (2012)	1999 to 2008	Generalized method of moments (GMM) and principal components	They find a significant and negative relationship between sentiment and future stock returns.
	Piccoli et al. (2018)	01/2006 to 12/2017	Two-stage least squares (2SLS)	Sentiment has an asymmetric, negative and significant relationship with volatility. These relationships are stronger in pessimistic periods and are sensitive to firm characteristics. In addition, the authors suggest that the Brazilian market has distinctive characteristics compared to developed markets, especially due to liquidity.
	Cainelli et al. (2020)	08/2011 to 09/2018	Regression analysis and determination of two fixed sample sub-periods (peak period and trough period)	They find that the IVol precedes the future returns of the Ibovespa in periods of high growth (high levels of future returns), but that in periods of low future returns, the IVol has a mixed effect and in many cases has no influence on the future returns of the Ibovespa.
	Ferreira et al. (2021)	01/2006 to 12/2017	Two-stage least squares (2SLS) and principal components	They find a negative and asymmetric relationship between volatility and market sentiment. These relationships are influenced by firm characteristics.

Source: *Prepared by the authors.*

Rehman et al. (2021) examined the causal relationship between the EPU, investor sentiment (individual investor survey) and stock returns in an industry analysis. They used a nonparametric approach to causality based on quantiles and reached similar conclusions to Ugurlu-Yildirim et al. (2021). The authors found asymmetric causality between the EPU, sentiment and US sector returns.

In light of the above, it is possible to see evidence of asymmetry and nonlinearity in the relationships between economic policy uncertainty, investor sentiment and market performance. Based on these considerations, it is feasible to formulate the following research hypothesis:

> H_1: The interactions between economic policy uncertainty, investor sentiment and market performance are mutually influential, with asymmetric and nonlinear effects over time.

It is essential to study the relationships between the variables of interest in the economic and political context of each country, as each one has unique characteristics (Rehman et al., 2021). By analyzing how these relationships develop in the Brazilian market, which is an emerging market with a high level of uncertainty, it is possible to assess whether these characteristics have the potential to differentiate the results found in local studies from those carried out in other markets. This can contribute to a deeper understanding of the specificities and dynamics of the Brazilian financial market. In this sense, this study advances by providing empirical evidence on a cycle of three relationships, jointly considering economic policy uncertainty, investor sentiment and the performance of the Brazilian market.

2.2 Autoregressive Nonlinear Modeling

The use of nonlinear models in capital markets is not new, as there is evidence that this approach is more appropriate for modeling financial time series (Franses & Van Dijk, 2000). In this study, we used the nonlinear autoregressive distributed lag (NARDL) approach proposed by Shin et al. (2014), which is a dynamic error correction representation capable of capturing asymmetries in the relationships between variables, both in the short and long run.

According to Nowzohour and Stracca (2020), the NARDL model is an asymmetric extension of the autoregressive distributed lag cointegration model (ARDL) (Pesaran & Shin, 1999), which allows the joint modeling of cointegration and nonlinearity. It is an alternative to autoregressive vector models because it performs better in the face of some characteristics of the series commonly reported in empirical studies in finance (Pereira et al., 2020).

The NARDL model only requires that none of the variables involved have an integration equal to or greater than two I(2), which is an advantage because it minimizes the risk of classification by unit root tests. In addition, the NARDL structure makes it possible to distinguish whether cointegration is linear, nonlinear (asymmetric) or non-existent, and reduces endogeneity problems (Ugurlu-Yildirim et al., 2021). According to Shin et al. (2014), the NARDL makes it possible to capture patterns of asymmetric adjustment after positive and negative shocks to the explanatory variables, which has considerable theoretical appeal because it allows new equilibria to be intuitively described after disturbances in the system.

Assuming that the long-term cointegrating regression is given by equation 1:

$$y_t = \beta^+ x_t^+ + \beta^- x_t^- + \gamma w_t + u_t \tag{1}$$

where y_t and x_t are the variables of interest, β^+ and β^- refer to the long-term parameters, x_t is a k * 1 vector of regressors of asymmetric effects, γ represents the coefficients of the control variables w_t, and u_t is an i.i.d. process.

Following the methodology of Shin et al. (2014), the starting point of the NARDL procedure requires the decomposition of x_t into $x_t = x_0 + x_t^+ + x_t^-$, where x_0 is characterized as the initial effect, while x_t^+ and x_t^- are partial sum processes of positive and negative changes in x_t, according to equations 2 and 3.

$$x_t^+ = \Sigma_{i=1}^t \Delta x_t^+ = \Sigma_{i=1}^t max(\Delta x_t, 0) \tag{2}$$

$$x_t^- = \Sigma_{i=1}^t \Delta x_t^- = \Sigma_{i=1}^t min(\Delta x_t, 0) \tag{3}$$

Despite being relatively recent, the NARDL model proposed by Shin et al. (2014) has been used by several researchers to study the capital market and its relationship with other variables (Oliveira et al., 2020; Liang et al., 2020; Ugurlu-Yildirim et al., 2021).

For Cho et al. (2021), the growing use of this methodology is due to its ease of implementation and interpretation. For these authors, the use of a threshold value of zero in the construction of partial sum processes provides an elegant interpretation in terms of positive and negative changes in the vector of explanatory variables, which is advantageous in circumstances where the sign of the change in an explanatory variable carries a natural interpretation.

3. METHODOLOGICAL PROCEDURES

3.1 Data and Variables

The analysis spans from August 2011 to April 2022, totaling 129 monthly observations. The timeframe was determined by the availability of the data series for the investor sentiment proxy, which is available from August 2011 to April 2022. The variables analyzed were: 1) the level of economic uncertainty, using as a proxy the Brazilian Economic Uncertainty Indicator (EPU_BR), provided by the Getulio Vargas Foundation; 2) investor sentiment, using as a proxy the Brazilian stock market volatility index (IVol), provided by the Brazilian Center for Research in Financial Economics at the University of São Paulo (Nefin); 3) market performance, using as a proxy the IBRX 100 index provided by the *Brasil, Bolsa, Balcão* (B3); 4) control variables, the broad consumer price index (IPCA), the basic interest rate of the economy (Selic) and the restricted means of payment (M1), all from Ipeadata.

The choice of proxies for economic uncertainty and investor sentiment was based on their representativeness with respect to the variable of interest and the Brazilian market. Both the EPU_BR and IVol were considered suitable as they are measures used in financial studies on market uncertainty (Phan et al., 2018; Cainelli et al., 2020; Gea et al., 2021; Franco, 2022) and differ not only in methodological terms but also in their focus. The EPU_BR is mainly based on textual analysis of local newspaper reports and expert consensus, and captures uncertainty related to economic policy. On the other hand, the IVol, known as the fear index, reflects investors' expectations of future market volatility, similar to the VIX in the United States.

Although other proxies exist, such as the EPU calculated using the methodology of Baker et al. (2016) and the Consumer Confidence Index (CCI), they were used as alternative formulations to analyze the robustness of the relationships. The results obtained with these alternative variables were similar to those of the original proxies, thus strengthening the conclusions of the study.

Table 2 shows the correlations between the measures of economic policy uncertainty and investor sentiment. As expected, the correlation between the CCI and the other variables is negative, indicating that an increase in sentiment (decrease in the CCI) is associated with an increase in uncertainty. IVol is positively correlated with EPU_BR and EPU, as an increase in IVol indicates an increase in pessimism when uncertainty is greater. Measures of economic policy uncertainty show a positive correlation.

Table 2
Correlations between proxies for economic policy uncertainty and investor sentiment

	CCI	IVol	EPU_BR	EPU
CCI	1			
IVol	–0.14	1		
EPU_BR	–0.49***	0.58***	1	
EPU	–0.48***	0.33***	0.45***	1

Note: *CCI and IVol are proxies for investor sentiment and represent the logarithm of the consumer confidence index and the logarithm of the implied volatility index for the Brazilian market, respectively; EPU_BR and EPU are proxies for economic policy uncertainty, representing the logarithm of the index calculated according to the methodology of Ferreira et al. (2019) and the logarithm of the index calculated according to the methodology of Baker et al. (2016), respectively; *** denotes statistical significance at 1%.*
Source: *Prepared by the authors.*

According to Baker et al. (2016), economic policy uncertainty and sentiment indices contain overlapping information that can predict the future movements of the economy. However, the authors point out that the relationships between these variables are unclear, and, therefore, empirical studies are lacking.

The variables were used in logarithmic form in the empirical models, except for the IPCA and Selic, which were used in rate form. The authors calculated the CUSUM/MOSUM limits to test for the presence of structural breaks and computed the Hurst exponent (R/S), which is usually used to classify the pattern of the time series over a given time horizon.

3.2 Model Specification and Testing

Consistent with the NARDL approach of Shin et al. (2014) and the study of Ugurlu-Yildirim et al. (2021), the relationships for analysis between IVol, EPU and IBRX can be represented by equations 4, 5 and 6, respectively.

$$\Delta IVOL_t = \mu + \rho IVOL_{t-1} + \lambda_1^+ EPU_{t-1}^+ + \lambda_1^- EPU_{t-1}^- + \lambda_2^+ IBRX_{t-1}^+ + \lambda_2^- IBRX_{t-1}^- + \Sigma_{j=1}^{k} \omega_j CV_{j,t-1} + \Sigma_{i=1}^{p-1} \tau \Delta IVOL_{t-i} + \Sigma_{i=0}^{q-1} \delta_1^+ \Delta EPU_{t-1}^+ + \Sigma_{i=0}^{q-1} \delta_1^- \Delta EPU_{t-1}^- + \Sigma_{i=0}^{q-1} \delta_2^+ \Delta IBRX_{t-i}^+ + \Sigma_{i=0}^{q-1} \delta_2^- \Delta IBRX_{t-i}^- + \Sigma_{i=0}^{q-1} \Sigma_{j=1}^{k} \theta_{ji} \Delta CV_{j,t-i} + \varepsilon_t \quad (4)$$

$$\Delta EPU_t = \mu + \rho EPU_{t-1} + \lambda_1^+ IVOL_{t-1}^+ + \lambda_1^- IVOL_{t-1}^- + \lambda_2^+ IBRX_{t-1}^+ + \lambda_2^- IBRX_{t-1}^- + \Sigma_{j=1}^{k} \omega_j CV_{j,t-1} + \Sigma_{i=1}^{p-1} \tau \Delta EPU_{t-i} + \Sigma_{i=0}^{q-1} \delta_1^+ \Delta IVOL_{t-1}^+ + \Sigma_{i=0}^{q-1} \delta_1^- \Delta IVOL_{t-1}^- + \Sigma_{i=0}^{q-1} \delta_2^+ \Delta IBRX_{t-i}^+ + \Sigma_{i=0}^{q-1} \delta_2^- \Delta IBRX_{t-i}^- + \Sigma_{i=0}^{q-1} \Sigma_{j=1}^{k} \theta_{ji} \Delta CV_{j,t-i} + \varepsilon_t \quad (5)$$

$$\Delta IBRX_t = \mu + \rho IBRX_{t-1} + \lambda_1^+ IVOL_{t-1}^+ + \lambda_1^- IVOL_{t-1}^- + \lambda_2^+ EPU_{t-1}^+ + \lambda_2^- EPU_{t-1}^- + \Sigma_{j=1}^{k} \omega_j CV_{j,t-1} + \Sigma_{i=1}^{p-1} \tau \Delta IBRX_{t-i} + \Sigma_{i=0}^{q-1} \delta_1^+ \Delta IVOL_{t-1}^+ + \Sigma_{i=0}^{q-1} \delta_1^- \Delta IVOL_{t-1}^- + \Sigma_{i=0}^{q-1} \delta_2^+ \Delta EPU_{t-i}^+ + \Sigma_{i=0}^{q-1} \delta_2^- \Delta EPU_{t-i}^- + \Sigma_{i=0}^{q-1} \Sigma_{j=1}^{k} \theta_{j,t-i} \Delta CV_{j,t-i} + \varepsilon_t \quad (6)$$

Each equation is estimated independently, where *IVOL*, *EPU_BR*, and *IBRX* are proxies for investor sentiment, economic uncertainty, and market performance, respectively, and *CV* represents the control variables; Δ is a difference operator of the variables; k is the number of control variables; the indices p and q are lag lengths chosen on the basis of the Akaike Information Criterion (AIC); the coefficients τ, δ_m and θ_{ij} represent the short-term relationships, while the coefficients ρ, λ_n and ω_j represent the long-term relationships, where $n = m = 1, 2$ and $j = 1, 2..., k$. The superscripts – and + represent the decomposition of the variables into negative and positive shocks, respectively. The error term is represented by ε_t.

As shown by Shin et al. (2014), the bounds test approach (Pesaran et al., 2001) can be applied to equations 4 to 6 to detect the presence of short- and long-term relationships between the variables. The *F*-test is used to test the null hypothesis of joint significance, where H_0: $\rho = \lambda^+_1 = \lambda^-_1 = \lambda^+_2 + \lambda^-_2 = \omega_1 = ... = \omega_j = 0$. If the *F*-statistic is greater than the critical values of the upper limit, we can conclude that there is a long-term relationship between the variables.

In the NARDL model, the Wald test is used to detect long- and short-term asymmetries. Therefore, if a long-term relationship is identified (bounds test), the Wald test is performed to check whether there is a statistically significant difference for the asymmetric coefficients in the long term, assuming H_0: $\beta^+ = \beta^-$, where $\beta^+ = \frac{-\lambda^+}{\rho}$ and $\beta^- = \frac{-\lambda^-}{\rho}$. If the null hypothesis is rejected, the magnitude of the negative (positive) shocks of the independent variable on the dependent variable will not be the same. In the short term, asymmetric dynamic multipliers are considered, which allow us to understand how the dependent variable adjusts in the short term to a new long-term equilibrium after a negative (positive) shock to the independent variable. This test allows us to understand the nature of the adjustment over time, assuming the hypothesis $H_0 : \sum_{i=0}^{q} \delta_j^+ = \sum_{i=0}^{q} \delta_j^-$.

The models were validated using diagnostic tests for normality of residuals (Shapiro-Wilk), serial correlation (Breusch-Godfrey), heteroscedasticity (Breusch-Pagan), and parameter stability using the CUSUM and CUSUMSQ plots. The analyses were performed using the free R software (R Core Team, 2020).

Control variables were included in the model to account for the potential impact of other market characteristics on the effects of interest (Pereira et al., 2020; Ugurlu-Yildirim et al., 2021). It should be noted that other variables, such as the effective exchange rate and the average real income of workers, were tested as control variables, but only the IPCA, Selic and M1 showed any statistical significance.

4. RESULTS AND DISCUSSION

4.1 Descriptive Analysis and Model Validation

Table 3 shows the descriptive statistics of the variables, including the results of the Shapiro-Wilk test and the number of differentiations required to make the variables stationary. The statistics indicate that the variables do not follow a normal distribution. According to Franses and Van Dijk (2000) and Ugurlu-Yildirim et al. (2021), this non-normality reinforces the need to take non-linearity into account in the analyses.

In addition, the Hurst exponent was calculated and values greater than 0.5 were obtained for the three series (IVol: 0.67; EPU_BR: 0.77; IBRX: 0.81). The series therefore have a long memory, further supporting the analysis proposed in the article.

In order to use ARDL models, whether linear or nonlinear, the variables must be integrated of order I(0) or I(1). To test for stationarity, the Augmented Dickey-Fuller (ADF) unit root test was applied. The results indicate that the investor sentiment and inflation variables are stationary at the I(0) level, while the other variables are stationary after the first I(1) difference. These results provide the necessary conditions for using the NARDL model to assess the cointegration relationships between the variables.

Table 3
Descriptive statistics for the monthly series from October 2011 to April 2022

	IVol	EPU_BR	IBRX	M1	IPCA	Selic
Mean	24.36	113.43	42.524	5.93	0.51	0.68
Median	22.83	111.70	39.578	5.75	0.47	0.71
Minimum	17.62	85.10	24.91	5.17	–0.59	0.13
Maximum	65.15	210.50	63.35	7.96	1.73	1.22
Standard deviation	5.97	19.75	9.12	0.78	0.36	0.28
Asymmetry	3.60	1.90	0.47	1.18	0.46	–0.11
Kurtosis	22.19	8.68	2.34	3.35	3.69	2.12
p-value (Shapiro-Wilk)	0.000	0.000	0.000	0.000	0.031	0.004
Integration	0	1	1	1	0	1

Note: *IVol, EPU_BR, IBRX, M1, IPCA and Selic represent investor sentiment, economic policy uncertainty, market performance, restricted means of payment, change of broad consumer price index and the economy's basic interest rate, respectively; integration indicates the number of differentiations to make the series stationary.*
Source: *Prepared by the authors.*

Before evaluating the estimated coefficients, it is necessary to test for the existence of a long-term equilibrium between the variables, i.e. cointegration. To do this, the bounds test is carried out, following the method proposed by Pesaran et al. (2001) and Shin et al. (2014). The results of this test are presented in Table 4, which includes both the ARDL (linear) and NARDL (nonlinear) results.

In this test, the joint null hypothesis is the absence of cointegration between the variables. Cointegration is present if, and only if, the calculated *F*-statistic exceeds the relevant critical upper limit at the 95% confidence level. Thus, the results obtained provide evidence in favor of the existence of a cointegrating relationship between the variables for the ARDL model (symmetric), in the models in which the dependent variable is the IVol and the EPU_BR. As for the model with the IBRX, the cointegration analysis is inconclusive.

For the NARDL (asymmetric) specification, the three equations present a cointegrating relationship. The observed difference between the ARDL and NARDL suggests that positive and negative shocks can be interpreted as events that affect the dynamics of the variables included in the model. These results are consistent with previous studies (Phan et al., 2018; Liang et al., 2020; Ugurlu-Yildirim et al., 2021).

Table 4
Results of the bounds test procedure

Model	Dependent variable	F calculated	95% lower limit	95% upper limit	Conclusion
Linear	IVol	5.008***	2.62	3.79	Cointegration
Nonlinear		8.212***	2.32	3.50	Cointegration
Linear	EPU_BR	4.601**	2.86	4.01	Cointegration
Nonlinear		6.187***	2.45	3.61	Cointegration
Linear	IBRX	3.274	2.86	4.01	Undefined
Nonlinear		3.947**	2.45	3.61	Cointegration

Note: *The F-statistic tests the null hypothesis of no long-term relationship; *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively; IVol, EPU_BR, and IBRX represent investor sentiment, economic policy uncertainty, and market performance, respectively.*
Source: *Prepared by the authors.*

As the *F*-test was significant for the NARDL model, the next step was to test for long- and short-term asymmetry in the relationship. To do this, the Wald test was performed, the results of which are shown in Table 5, rejecting the null hypothesis of a symmetric relationship. This indicates that in both the short and long run, the positive and negative partial sums are significantly different.

Table 5
Wald test for long- and short-term asymmetry

Panel A – Long-term asymmetry (W_{LR})			
	IVol	**EPU_BR**	**IBRX**
IVol		5.97***	6.46***
EPU_BR	2.70*		4.34***
IBRX	3.89*	4.89***	
Panel B – Short-term asymmetry (W_{SR})			
	IVol	**EPU_BR**	**IBRX**
IVol		5.38**	29.4***
EPU_BR	6.35***		7,54***
IBRX	7.14***	7.35***	

Note: *The values in the table represent the coefficients of the Wald test for the null hypothesis of symmetry in the long term ⟦(W⟧_LR) and short term (W_SR); *, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively; IVol, EPU_BR, and IBRX represent investor sentiment, economic policy uncertainty, and market performance, respectively.*
Source: *Prepared by the authors.*

These results provide evidence that the shocks suffered by IVol, IBRX and EPU_BR have an asymmetric transmission in the long and short run. However, this effect is marginal for the long-term causality of EPU_BR and IBRX on IVol, considering that the rejection of the hypothesis for this model occurs only at the 10% significance level. According to Liang et al. (2020) and Ugurlu-Yildirim et al. (2021), these asymmetries are natural and expected due to the presence of different types of agents interacting in the financial market, such as speculators, investors, policy makers and arbitrageurs. This leads to differentiated future expectations due to the sensitivity of each of them to macroeconomic conditions and available information.

Tables 6 to 8 below show the results of the representation of the NARDL error correction model, considering the three equations formulated, one for each dependent variable: IVol, EPU_BR, and IBRX. Panel A shows the estimated coefficients for the model. Panel B shows the long-term coefficients associated with the positive and negative changes of the independent variables over the dependent variables. With these coefficients, the asymmetric cointegration equation is obtained. Panel C shows the error correction term (ECT_(t-1)), which represents the speed with which short-term imbalances caused by shocks to the independent variables are absorbed, i.e. when the model returns to long-term equilibrium. The tests carried out to validate the models are shown in panel D of each table. The results obtained provide evidence of a correct specification for all the models, since the CUSUM/MUSUMSQ tests did not provide evidence of the presence of structural breaks in the model parameters.

The interpretation of asymmetric coefficients is as follows: (i) for a statistically significant and negative coefficient, in the case of negative (β^-) or positive (β^+) shocks, there will be a negative relationship between the explanatory variable and the dependent variable, i.e. the percentage increase (decrease) in the explanatory variable tends to lead to a percentage decrease (increase) in the dependent variable; (ii) for a statistically significant and positive coefficient, in the case of negative (β^-) or positive (β^+), shocks, there will be a positive relationship, and in this case the percentage increase (decrease) in the explanatory variable tends to lead to a percentage increase (decrease) in the dependent variable.

4.2 Model Analysis for Investor Sentiment

Table 6 shows the result for the nonlinear effects of economic policy uncertainty and market performance on investor sentiment (equation 4). It can be seen that, in the long run, only positive shocks to the economic policy uncertainty series (EPU_BR), lagged by one period, have a positive and significant relationship with investor sentiment (IVol). The results thus suggest that the increase in economic policy uncertainty precedes the increase in negative investor sentiment.

Table 6
NARDL model results and model fit indicators (IVOL)

Panel A – Estimated coefficients			
Long term		**Short term**	
$IVol_{t-1}$	-0.644^{***}	$\Delta IVOL_{t-2}$	0.309^{***}
$EPU\_BR^+_{t-1}$	0.767^{***}	$\Delta EPU\_BR^+_t$	0.964^{***}
$EPU\_BR^-_{t-1}$	0.170	$\Delta EPU\_BR^-_t$	0.858^{**}
$IBRX^+_{t-1}$	-0.566^{***}	$\Delta IBRX^+_{t-1}$	0.689^{**}
$IBRX^-_{t-1}$	0.016	$\Delta IBRX^+_{t-2}$	0.586^{**}
$IPCA_t$	-0.076^{**}	$\Delta IBRX^-_t$	-1.474^{***}
$M1_{t-1}$	–0.007	$\Delta IBRX^-_{t-1}$	-1.070^{***}
$Selic_t$	-0.130^{*}	$\Delta IBRX^-_{t-2}$	–0.413
Constant	2.207^{***}	$\Delta M1_{t-1}$	-1.354^{**}
Panel B – Long-term coefficients associated with positive and negative changes			
$L_{EPU\_BR}^+$	1.21^{**}	$L_{EPU\_BR}^-$	0.23
L_{IBRX}^+	-0.91^{***}	L_{IBRX}^-	0.04
Panel C – Error correction term			
ECT_{t-1}			-0.61^{***}
Panel D – Fit tests			
Adjusted R^2	0.712	Shapiro-Wilk test	0.98 (p-value 0.12)
Breusch-Godfrey test	0.90 (p-value 0.40)	RESET test (Ramsey's)	1.33 (p-value 0.18)
Breusch-Pagan test	0.80 (p-value 0.69)	CUSUM and CUSUMSQ	Stable

Note: *IVol, EPU_BR, IBRX, M1, IPCA and Selic represent investor sentiment, economic policy uncertainty, market performance, restricted means of payment, the broad consumer price index and the economy's basic interest rate, respectively; the variables are in log, except for IPCA and Selic, which are originally in percentage changes; the L operator indicates the long-term estimates associated with positive (+) and negative (-) changes, defined by* $\beta^+ = -\frac{\lambda^+}{\rho}$ *and by* $\beta^- = -\frac{\lambda^-}{\rho}$*, respectively; *, ** and *** indicate statistical significance at 10%, 5% and 1%, respectively.*
Source: *Prepared by the authors.*

These results corroborate the findings of Marschner and Ceretta (2021), who point to economic uncertainty as one of the variables with the potential to create outbreaks of pessimism among investors in the Brazilian market. Moreover, although the observed effect is only for positive shocks to the EPU_BR, its asymmetric effect is statistically confirmed. As pointed out by Guenich et al. (2022), this effect should be a factor controlled by market regulators, since it influences the formation of investors' future expectations.

Also in the long run, positive shocks to the IBRX have a significant and negative impact on the IVol. This suggests that a 1% increase in market performance tends to reduce negative investor sentiment by 0.91%. These results are in line with expectations, as upward market cycles (positive shocks) are associated with lower levels of uncertainty and more optimistic investors (Shaikh, 2019).

Similar relationships are observed for the short term. Positive (negative) shocks to the current EPU_BR are significant and lead to an increase (decrease) in the level of investor pessimism. Looking at the magnitudes of the short-term effects, it can be seen that positive shocks to uncertainty have a greater potential to generate negative sentiment than negative shocks to uncertainty have to generate positive sentiment.

In addition, the results suggest that in the short run, both positive and negative shocks to the IBRX have a negative impact on investor sentiment. As described by Bakas and Triantafyllou (2018), these short-term price shocks increase the difficulty of predicting future market movements, which can negatively affect investor sentiment. In terms of magnitude, the impact of negative shocks, i.e. declining market returns, on sentiment is greater than that of positive shocks.

The adjustment time determined by the error correction mechanism of the NARDL model (ECT_{t-1}) for IVOL as the dependent variable in equation 4 is statistically significant and negative, indicating an adjustment speed of approximately 1.6 months.

Taking into account the control variables, it was found that in the long run an increase in inflation and the basic interest rate reduces IVol. These results differ from those found in studies such as that of Marschner and Ceretta (2021), since an increase in the basic rate is associated with the need of the Brazilian Central Bank to control inflation, which could have negative effects on economic activity (Garcia, 1999).

There are two possible reasons for these results. First, for some investors, a tighter monetary policy can convey a sense of stability and control over the economy. This reduces expectations of large swings in the prices of financial assets (Levy, 2015). Second, the interest rate is the benchmark for the remuneration of fixed-income instruments, so if it is perceived as high, which is common in the Brazilian context, there is an incentive for investors to reallocate their resources to these instruments. This phenomenon is known as "flight to safety" (Tversky & Kahneman, 1991), and this structure of resource allocation can affect investors' perceptions, generating a different response in terms of the sensitivity of the IVol to the control variables in the Brazilian market.

In the short run, inflation and interest rates are not significant, but the monetary aggregate (M1) lagged by one period is. M1 is interpreted in a similar way to inflation and interest rates because it represents the availability of liquidity and can lead to an increase in consumption (decrease in sentiment).

4.3 Model Analysis for Economic Uncertainty

Table 7 shows the results when uncertainty (EPU_BR) is taken as the dependent variable (equation 5). It can be seen that both positive and negative shocks to IVol have a positive relationship with EPU_BR. However, positive shocks are only marginally significant at the 10% level. This implies that any increase (decrease) in negative investor sentiment leads to a corresponding increase (decrease) in uncertainty. Notably, a decrease in pessimistic investor sentiment has a more significant impact on reducing EPU_BR levels.

Table 7
NARDL model results and model fit indicators (EPU_BR)

Panel A – Estimated coefficients			
Long term		**Short term**	
EPU_BR_{t1}	-0.303^{***}	$\Delta IVOL^{+}_{t}$	0.235^{***}
$IVol^{+}_{t-1}$	0.096^{*}	$\Delta IVOL^{+}_{t-1}$	0.105^{**}
$IVol^{-}_{t}$	0.175^{***}	$\Delta IBRX^{+}_{t-1}$	−0.117
$IBRX^{+}_{t-1}$	0.110^{**}	$\Delta IBRX^{+}_{t-2}$	-0.321^{***}
$IBRX^{-}_{t}$	−0.094	$\Delta M1_{t}$	0.575^{**}
$M1_{t-1}$	0.093	$\Delta M1_{t-1}$	0.794^{***}
$Selic_{t}$	0.095^{**}	$\Delta M1_{t-2}$	0.370
Constant	1.182^{***}		
Panel B – Long-term coefficients associated with positive and negative changes			
L_{IVol}^{+}	0.320^{*}	L_{IVol}^{-}	0.578^{***}
L_{IBRX}^{+}	0.363^{*}	L_{IBRX}^{-}	−0.310

Table 7
Cont.

Panel C – Error correction term			
ECT_{t-1}			-0.30^{***}
Panel D – Fit tests			
Adjusted R^2	0.621	Shapiro-Wilk test	0.989 (p-value 0.44)
Breusch-Godfrey test	0.218 (p-value 0.80)	RESET (Ramsey's) test	1.227 (p-value 0.22)
Breusch-Pagan test	1.243 (p-valor 0.24)	CUSUM and CUSUMSQ	Stable

Note: *IVol, EPU_BR, IBRX, M1, IPCA and Selic represent investor sentiment, economic policy uncertainty, market performance, restricted means of payment, the broad consumer price index and the economy's basic interest rate, respectively; the variables are in log, except for IPCA and Selic, which are originally in percentage changes; the L operator indicates the long-term estimates associated with positive (+) and negative (-) changes, defined by* $\beta^{+} = -\frac{\lambda^{+}}{\rho}$ *and by* $\beta^{-} = -\frac{\lambda^{-}}{\rho}$*, respectively; *, ** and *** indicate statistical significance at 10%, 5% and 1%, respectively.*
Source: *Prepared by the authors.*

These results suggest that uncertainty tends to increase when investors are more pessimistic, possibly reflecting concerns about the future of the economy (Ugurlu-Yildirim et al., 2021). In contrast, uncertainty tends to decrease when investors are more optimistic, reflecting more positive expectations about economic performance (Liang et al., 2020). In the long run, the relationship between IBRX and EPU_BR suggests that only positive, one-period lagged shocks to the IBRX have significant effects on uncertainty. It was found that a 1% increase in the IBRX is associated with a 0.36% increase in the EPU_BR. This may be related to speculative movements due to overconfidence during periods of market expansion, as pointed out by Franco (2022).

For short-term relationships, it can be seen that positive shocks to the IVol (more pessimistic sentiment) have a positive impact on the EPU_BR. Furthermore, in optimistic scenarios regarding market performance (positive shocks to the IBRX), there is an association with lower levels of uncertainty. These results confirm the findings of Ugurlu-Yildirim et al. (2021), Marschner and Ceretta (2021), Rehman et al. (2021) and Franco (2022).

The differences found between the long-term and short-term effects may be the result of different investor strategies. In the long run, they may see opportunities for greater gains associated with uncertainty, while in the short run this uncertainty becomes undesirable.

The short-term adjustment to the long-term equilibrium provided by ECT_{t-1} for equation 5 is negative and statistically significant. This suggests that the relationship returns to equilibrium after a shock in approximately 3.3 months.

For the control variables, there is a positive and significant effect of the Selic rate in the long run. This indicates that an increase in the basic interest rate causes an increase in uncertainty. One possible cause, especially in the Brazilian context, could be related to consumption capacity and unpredictability in relation to inflation (Levy, 2015).

In the short run, growth in the monetary aggregate (M1) leads to an increase in the EPU_BR. Ugurlu-Yildirim et al. (2021) also used the monetary aggregate as a control variable in their study applied to the American market, but found an inverse relationship to that found in this study. The authors suggest that since M1 is a highly liquid asset, it is quickly converted into currency and consequently into consumption, leading to an expansionary cycle and creating an environment of greater certainty. However, the Brazilian market has some peculiarities that may explain the differences found. According to Marschner and Ceretta (2021), Brazil is anchored in a process of hyperinflation and, as a result, every time there is a stimulus to consumption, there are concerns about the inflationary process, which can generate a higher level of uncertainty.

4.4 Model Analysis for Capital Market Performance

Table 8 shows the result with IBRX as the dependent variable (according to equation 6). It was found that although the effects are statistically asymmetric, they are not statistically significant on market performance for long-term relationships. Phan et al. (2018) assessed the relationship between EPU and excess returns in the stock market and also found no significant relationships for the Brazilian market. Similarly, Ugurlu-Yildirim et al. (2021) found no long-term relationship between these variables for the American market. Using a different methodology, Pereira et al. (2020) found similar results regarding the difficulty of finding predictors of market performance.

Table 8
NARDL model results and model fit indicators (IBRX)

Panel A – Estimated coefficients			
Long term		**Short term**	
$IBRX_{t-1}$	-0.199^{***}	$\Delta IBRX_{t-2}$	-0.175^{**}
$IVol^{+}_{t-1}$	-0.040	$\Delta IVOL^{+}_{t}$	-0.328^{***}
$IVol^{-}_{t-1}$	0.056	$\Delta IVOL^{-}_{t-1}$	-0.146^{**}
$EPU\_BR^{+}_{t-1}$	0.115	$\Delta EPU-BR^{+}_{t-2}$	-0.332^{***}
$EPU\_BR^{-}_{t}$	-0.123		
$IPCA_{t}$	-0.031^{**}		
$Selic_{t}$	-0.063^{*}		
Constant	2.162^{***}		
Panel B – Long-term coefficients associated with positive and negative changes			
L_{IVol}^{+}	-0.239	L_{IVol}^{-}	0.128
$L_{EPU\_BR}^{+}$	0.439	$L_{EPU\_BR}^{-}$	-0.491
Panel C – Error correction term			
ECT_{t-1}			-0.22^{***}
Panel D – Fit tests			
Adjusted R^2	0.476	Shapiro-Wilk test	0.981 (p-value 0.09)
Breusch-Godfrey test	1.086 (p-value 0.34)	RESET (Ramsey's) test	0.698 (p-value 0.40)
Breusch-Pagan test	0.993 (p-value 0.46)	CUSUM and CUSUMSQ	Stable

Note: *IVol, EPU_BR, IBRX, M1, IPCA and Selic represent investor sentiment, economic policy uncertainty, market performance, restricted means of payment, the broad consumer price index and the economy's basic interest rate, respectively; the variables are in log, except for IPCA and Selic, which are originally in percentage changes; the L operator indicates the long-term estimates associated with positive (+) and negative (-) changes, defined by* $\beta^{+}=-\frac{\lambda^{+}}{\rho}$ *and by* $\beta^{-}=-\frac{\lambda^{-}}{\rho}$*, respectively; *, ** and *** indicate statistical significance at 10%, 5% and 1%, respectively.*
Source: *Prepared by the authors.*

Looking at the short run, the effects of the IVol on the IBRX are statistically significant for both positive and negative shocks, and show a negative relationship in both cases. These results highlight the asymmetry of short-term shocks and suggest that pessimistic investor sentiment (higher levels of IVol) can lead to more conservative asset valuations and lower market returns, corroborating the results of Zhang (2019) and Rehman et al. (2021). In addition, the recovery of the IBRX from positive IVol shocks is slower and the effect of these shocks is greater in magnitude compared to negative shocks. This is because investors are more likely to sell assets in pessimistic scenarios compared to their propensity to buy assets in more optimistic scenarios. Moreover, investors demand a higher risk premium in optimistic scenarios (lower levels of IVol) (Piccoli et al., 2018).

It should also be noted that positive shocks to the EPU_BR lead to a reduction in IBRX levels. This result corroborates the findings of Liang et al. (2020) and Gea et al. (2021) on the dampening effect of uncertainty on markets, as positive shocks to uncertainty are expected to cause stock prices to fall. The opposite is also true, but for the data analyzed, no significant effects were found for negative shocks.

The short-term adjustment rate for the long-term equilibrium provided by ECT_{t-1} in the model with IBRX as the dependent variable is negative and statistically significant, with an adjustment period of 4.5 months. This period is longer than that observed in the models with IVol and EPU_BR as dependent variables.

With respect to the control variables, Selic and IPCA were statistically significant, both with a negative effect on the IBRX in the long term. Pereira et al. (2020) discussed this difficulty in explaining the returns of the Brazilian stock market, suggesting that increases in the basic interest rate and inflation lead to a reduction in market performance levels. This behavior is to be expected, since the market is the sum of company values, and an increase in the basic interest rate increases the discount rate, leading to a decrease in the valuation of companies. Similarly, returns on financial market assets tend to be negatively affected by inflation (Marschner & Ceretta, 2021).

Looking at the results obtained for all the relationships analyzed using equations 4 to 6, one can see the behavior and complexity of the short- and long-term relationships between the different variables, as shown in Figure 1.

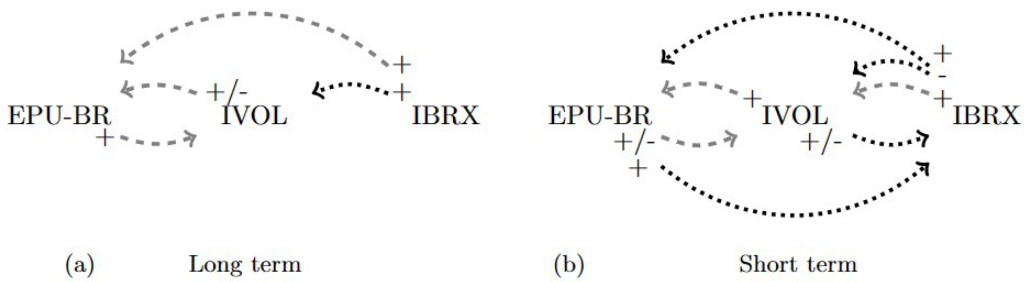

Figure 1 *Diagrams of the relationships identified for EPU_BR, IVOL and IBRX*
Note: *The dashed directional arrows in gray indicate positive relationships between the variables, i.e. a negative (positive) shock to the explanatory variable will lead to a decrease (increase) in the explained variable; the dotted directional arrows in black indicate that the relationships are negative, i.e. a negative (positive) shock to the explanatory variable will lead to an increase (decrease) in the explained variable; the signs at the beginning of the arrows indicate whether the shocks with statistical significance are positive (+) or negative (-).*
Source: *Prepared by the authors.*

Based on the diagrams constructed from the results of the NARDL model, we can conclude that the hypothesis initially raised is partially supported. The effects found are asymmetric and there is evidence of short- and long-term cointegration between the variables.

5. CONCLUDING REMARKS

The study analyzed the interactions between investor sentiment, economic policy uncertainty and stock market performance, considering both short- and long-term relationships, with a focus on possible asymmetries, using the NARDL model.

The main results show that, in the long run, there is a bidirectional positive causal relationship for positive shocks between uncertainty (EPU_BR) and investor sentiment (IVol), and a unidirectional positive relationship for negative shocks from IVol to EPU_BR. However, the relative strength of the effect of lagged EPU_BR on IVol, for both negative and positive shocks, is greater than the effect of contemporaneous and lagged IVol on EPU_BR. Significant unidirectional positive relationships were also found for positive shocks from market performance (IBRX) to EPU_BR, and unidirectional negative relationships for positive shocks from IBRX and IVol.

These results provide evidence that periods of high market sentiment are preceded by greater investor sentiment, which in turn generates movements in the EPU_BR. Thus, if the IVol decreases (increases), the EPU_BR decreases (increases). However, negative shocks to the IVol are more significant and have a greater effect on reducing the EPU_BR. This suggests that market declines can have a cascading effect, negatively impacting investor sentiment and increasing economic uncertainty. The relationship between the IBRX and the EPU_BR is also positive and unidirectional, i.e. positive shocks to the IBRX lead to an increase in the EPU_BR. This is an unexpected relationship that may be the result of speculative movements and profit-taking after upward movements. No significant long-term causal effects of the IVol and EPU_BR on the IBRX were found, in line with other studies on this topic.

In the short run, bidirectional relationships were identified for positive shocks between EPU_BR and IVol, positive and negative shocks of IBRX and IVol, and positive shocks of IBRX and EPU_BR. For negative EPU_BR shocks, a positive and unidirectional relationship is observed for IVol. In these relationships, current positive (negative) EPU_BR shocks have a greater relative impact on the growth (decline) of IVol, just as the relative impact of negative IBRX shocks on IVol are greater.

Thus, looking at the short run, it can be seen that upward or downward shocks to market prices precede an increase in investor pessimism, with negative shocks having a greater relative impact than upward shocks. The increase in pessimistic sentiment, in turn, precedes an increase in economic policy uncertainty. Moreover, increased uncertainty leads to a decline in market performance, while increased performance reduces uncertainty.

The evidence found partially validates the hypothesis raised by the study, confirming the existence of asymmetric relationships, but not the existence of a mutual effect for all the relationships evaluated. The results are consistent with those of other studies conducted in different markets (Ugurlu-Yildirim et al., 2021; Rehman et al., 2021). However, some differences are observed regarding the effects of the macroeconomic factors used as control variables in this study. This suggests that the dynamics of the Brazilian market may affect these relationships due to local specificities, such as the country's inflationary history. In addition, the institutional and regulatory characteristics of emerging markets may affect the way macroeconomic factors relate to the variables studied.

In general, the results show that EPU_BR, IVol and IBRX are interconnected through asymmetric relationships, with stable equilibrium relationships and temporary fluctuations around this long-term relationship. These findings can help investors to understand how changes in one variable can affect the others over time and to improve their decisions (e.g., by adjusting their investment strategies according to the relationships identified, allowing them to anticipate possible market movements).

The results show that the relationships between investor sentiment, economic policy uncertainty and stock market performance are more complex than previous studies have suggested for the Brazilian market. We identified short- and long-term asymmetric relationships that not only partially validated the hypothesis raised, but also confirmed the importance of taking into account the local characteristics of the market under study. Therefore, the study and its results contribute to a deeper understanding of the topic and highlight the advantages of using the NARDL technique in a different context.

However, there are limitations to this study. One is the sample size, which was limited by the data series used as a proxy for investor sentiment. In addition, it is suggested that future work include comparisons with other emerging markets to understand how the relationships studied behave in different contexts.

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