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# Sentiment and economic activity in Brazil

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## Abstract

**Purpose** – The purpose of this study is to analyze how sentiment affects economic activity in Brazil.
**Design/methodology/approach** – Based on a nonlinear autoregressive distributed lag (NARDL) model, this study examines in detail the short-term and long-term asymmetric impacts between the variables during the period from January 2007 to December 2020.
**Findings** – There are three main results of this study. First, sentiment is an important factor for economic activity in Brazil, and its effect possibly occurs through the channels of consumption and investment, which are the two main components of economic growth. Second, sentiment affects economic activity in different ways in the short and the long term: in Brazil, although in the short-term, immediate shocks of sentiment may be confusing, the negative shocks from previous periods have a negative impact on economic activity. Third, the effect of shocks of optimism and pessimism on economic activity is asymmetric, and in the long run, only shocks of optimism have a significant and positive impact.
**Originality/value** – The relationship between sentiment and economic activity is still a controversial issue in the literature and this study seeks to advance its understanding in Brazil.

**Keywords** Sentiment, Economic activity, Uncertainty
**Paper type** Research paper

## 1. Introduction

Sentiment variables have long been believed to carry information about future fluctuations in the level of economic activity (Christiansen, Eriksen & Møller, 2014). The literature on this topic is little explored and many studies also use the term "confidence." Previous studies have analyzed the role of confidence from two different perspectives. The traditional perspective, popularized by Keynes (1936) and reinvigorated in Akerlof and Shiller (2009), argues that confidence reflects waves of optimism and pessimism driven by partially independent "animal spirits," with little connection with economic fundamentals. Another perspective, commonly called informational, argues that confidence is related to fundamental information about the future state of the economy (Barsky & Sims, 2012) and that they influence each other by creating a feedback loop (Ilut & Saijo, 2021).

These two perspectives differ in the treatment of sentiment as an exogenous (Lemmon & Portniaguina, 2006; Kumar & Lee, 2006; Lorenzoni, 2009; Hassan & Mertens, 2011; Farmer, 2012; Angeletos & La'O, 2013; Guo & He, 2020) or endogenous variable (Acemoglu & Scott, 1994; Barsky & Sims, 2012; Ilut & Saijo, 2021; Kabiri, James, Landon-Lane, Tuckett, &

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Nyman, 2022), and although all these studies confirm its importance for the economy, its role has not yet been fully explored, especially in developing countries. In Brazil, an important emerging economy, there is little evidence about this relationship. Furthermore, it is known that economic activity is impacted at different speeds by shocks of sentiment. Barsky and Sims (2012) argued that shocks of sentiment are likely to have an immediate and transient impact on economic activity; and while positive shocks for "animal spirits" may look like positive shocks for aggregate demand in the short term, they will end up being weakened if not followed by real increases in productivity. Benhabib and Spiegel (2018) also support a positive empirical relationship between sentiment and future economic activity and find evidence that this impact is weaker over longer horizons.

From this evidence, it is clear that there is an intuitive idea that shocks of sentiment impact economic activity in different ways in the short and the long term. We also observed that although there is evidence of the impact of positive shocks, the impact of negative sentiment shocks is still little explored in the literature. This perspective is relevant because different levels of confidence can lead to different economic balances (Farmer, 2012). Considering this theoretical gap, we analyze the impact of sentiment shocks on economic activity and explore this relationship in Brazil, one of the main and largest emerging economies in the world. For this, we use a non-linear autoregressive distributed lag (NARDL) model to study the relationship between the variables. The NARDL model is suitable for this purpose because, in addition to capturing short- and long-term relationships, it isolates positive and negative components from the independent variables, which allows to verify the impact of positive sentiment shocks (optimism) and negative sentiment shocks (pessimism) on economic activity.

The main results of this research indicate that economic activity in Brazil is affected by shocks of optimism and pessimism in different ways in the short and the long term. We also found that the impact of sentiment is asymmetrical and that although in the short term, the shocks can be confusing, in the long term, only optimism shocks affect economic activity. This study makes important contributions to literature. First, it explores the impact of sentiment on economic activity in an important emerging economy. Second, it provides evidence that sentiment impacts economic activity in different ways in the short and the long term, corroborating previous propositions (Barsky & Sims, 2012; Benhabib & Spiegel, 2018) that this impact can occur at different speeds. Added to this perspective is the evidence that the sign of the shocks is also important in determining the impact. Third, it detects that shocks of optimism and pessimism can asymmetrically affect economic activity.

Studies in this stream of literature had already found evidence that sentiment is an important factor of economic fluctuation (Angeletos & La'O, 2013; Ilut & Saijo, 2021; Guo & He, 2020), but few observed that this effect could be asymmetrical and nonlinear. Concerning previous studies, in addition to corroborating their theoretical assumptions, we sought to advance methodologically using an econometric model capable of detecting deeper connections between variables. This evidence is important for Brazil, where this relationship is little explored, especially the possible nonlinear effects highlighted in Mello and Figueiredo (2017). Our results add to a limited number of studies in emerging countries, address this issue with robust empirical evidence and explain why investors, consumers, governments and monetary authorities should be more concerned with sentiment, especially with the impacts of pessimism.

## 2. Literature review

According to Nowzohour and Stracca (2020) on economic issues, sentiment can describe the views of economic agents about future economic developments that can boost the economy, a view that can reflect totally rational arguments and facts but also a climate of optimism or pessimism. In the traditional perspective (Keynes, 1936; Akerlof & Shiller, 2009), sentiment is

treated as an exogenous shock. This means that the agents are not entirely rational and do not make their decisions based on the fundamentals. Lemmon and Portniaguina (2006) and Kumar and Lee (2006) showed that consumer confidence and investor sentiment can predict stock returns and that this result cannot be explained by macroeconomic news or reviews of analysts' earnings forecasts. Lorenzoni (2009) indicated that consumers take a while to recognize economic fundamentals, and public information provides only a noisy forecast, which leads them to a temporary overestimation or underestimation of productive capacity, which ends up affecting the economy.

Hassan and Mertens (2011) indicated that market sentiment is exogenous and alters investors' expectations regarding the payment of risky assets. In Farmer (2012), confidence is also exogenous and captures the role of psychology in the stock market. Angeletos and La'O (2013) developed a new theory of fluctuations that seeks to accommodate the notions of "animal spirits" and "market sentiment" in a unique balance and showed that sentiment is a certain type of extrinsic shock that affects sets of information without affecting the real aggregate fundamentals or agents' beliefs about them. In a comprehensive study involving 41 countries between 1991 and 2017, Guo and He (2020) found that confidence positively affects economic growth and that this effect is greater in periods of recession or in times of low confidence, where the effects of monetary and fiscal policies are more significant, and therefore, governments should pay more attention to confidence when trying to stimulate the economy.

In the informative perspective, sentiment is related to fundamental information about the economy and, therefore, is endogenous to the system. According to Guo and He (2020), in this perspective, the agents are rational, and their sentiment can be predicted by prospective variables. Acemoglu and Scott (1994) analyzed whether consumer sentiment is a good predictor of current and future consumption, and whether it has predictive power above standard macroeconomic variables. The authors conclude that consumer sentiment reflects the private information of agents, but it is also influenced by macroeconomic variables; they also indicated that the growth in labor income (or any other macroeconomic variable) does not predict future consumption growth, while trust does.

Using vector autoregressive models (VAR), Barsky and Sims (2012) conclude that the predictive power of confidence is not likely to reflect a causal effect of animal spirits on economic activity. Instead, they suggest that fundamental news is the driving force behind the predictive power of confidence. Ilut and Saijo (2021) considered the feedback between the agents' degrees of confidence and the endogenous state of the economy and proposed a mechanism for the propagation of endogenous confidence. According to the authors, when the economy experiences economic slack, maintaining and restoring confidence becomes even more important than in normal times because if the agents' confidence falls along with economic growth, it will trigger a cycle of feedback and further discourage economic activity. Kabiri *et al.* (2022) investigated the role of sentiment in the US economy from 1920 to 1934. The authors constructed a sentiment index based on more than 250,000 news stories from *The Wall Street Journal* focused on business, finance and the economy, which makes this index seemingly endogenous to the fundamentals. From an error correction model, it was found that sentiment shocks had economically significant effects on industrial production, the S&P500 stock market index, bank loans and credit spreads.

Although these works can contrast in the treatment of sentiment as endogenous or exogenous, they corroborate its importance for economic activity. According to Christiansen *et al.* (2014), sentiment variables are more than just a summary of other variables: in fact, they contain information relevant to the forecast of recessions that are usually associated with financial instability, credit restrictions, business failures and job destruction. However, the relationship between sentiment and economic activity is still complex and little explored and improving the understanding of this relationship is essential for policymakers, governments

and monetary authorities to better understand this important element. In Brazil, evidence on this relationship is scarce and incipient. According to Mello and Figueiredo (2017), trust provides relevant information about economic activity in Brazil. Nonetheless, the authors draw attention to possible effects of nonlinearity that may exist in these variables, a context not yet explored in the Country.

## 3. Data and method

We use the Consumer Confidence Index (CCI) as a proxy for sentiment (Sent). This choice is similar to that made in previous studies (Barsky & Sims, 2012; Christiansen *et al.*, 2014) that also use the scores of opinion indexes. The CCI is based on a monthly sample of approximately 2,000 Brazilians residing in the major State capitals of Brazil and measures consumer sentiment in relation to the country's general economic situation, household financial situation, labor market conditions, savings, intention to purchase durable goods and expectations regarding inflation and interest rates (FGV/IBRE, 2021). This information is collected by the "Brazilian Institute of Economics" (*Instituto Brasileiro de Economia*) of Fundação Getúlio Vargas (FGV) by telephone and over the Internet.

As in Guo and He (2020), we assume that sentiment is not in itself an endogenous response to economic fundamentals. According to the authors, the confidence of agents is the product of public domain historical economic data and of their intuitive sentiments about the current economy. It is difficult to believe that any individual has the capacity to correctly judge all macroeconomic situations and that their sentiments are always intuitive.

For economic activity, we use the Industrial Production Index (Ea), widely employed in behavioral research (Christiansen *et al.*, 2014). We also included in our model the Brazilian Economic Uncertainty Index (Eun) as a control variable. This is done to mitigate and dilute the response of the dependent variable that would be linked entirely to the measure of sentiment. It is a consensus in economic theory that uncertainty has contractionary effects on economic activity, both in traditional models of real options, as well as in models with risk premium and default (Barboza & Zilberman, 2018). Through several channels, but mainly through investment, the negative effect of uncertainty on economic activity is substantially documented in the international literature (Bloom, 2009; Bachmann, Elstner & Sims, 2013; Baker, Bloom & Davis, 2016; Scotti, 2016; Leduc & Liu, 2016; Basu & Bundick, 2017). In Brazil, the evidence follows the same flow. According to Barboza and Zilberman (2018), increases in uncertainty negatively affect economic activity and, therefore, can be considered an essential variable in determining Brazil's economic cycle.

Eun is measured from three components: (1) media, (2) expectation and (3) market. The three components together minimize the impacts that each factor alone can have on the final index. The media component is based on the frequency of news mentioning uncertainty in print and online media, with a weight of 70%. The expectation component is built from the dispersion of experts' forecasts for the exchange rate and inflation, with a weight of 20%. The market component is based on the stock market volatility (Ibovespa), with a weight of 10%. Eun components make this index a comprehensive reflection of economic behavior, with the potential to carry important variations in monetary and fiscal policy, thus constituting an ideal variable to be included in the NARDL modeling, which does not allow for a large number of independent variables.

It is important to note that sentiment and uncertainty differ. According to Knight (2012), sentiment can be considered a strong belief in future economic developments, which may be the result of "animal spirits" and/or news about future economic developments; on the other hand, uncertainty can be the range of possible outcomes of future economic developments (risk) and/or the lack of knowledge of the probability distribution from which these developments are extracted (ambiguity).

We obtained monthly data from January 2007 to December 2020, the period of available data for Brazil. The CCI and Eun were obtained from FGV and the Ea was collected from the data of the "Institute for Applied Economic Research" (*Instituto de Pesquisa Econômica Aplicada*, IPEA). Table 1 presents a summary of the descriptive statistics.

We observed that all variables in both level and logarithm have very similar characteristics, particularly, in the mean values. All variables showed an asymmetric and leptokurtic distribution due to the values associated with asymmetry and kurtosis. Sentiment has a greater standard deviation than economic activity, naturally implying that sentiment is more oscillating.

### 3.1 NARDL model

Based on the studies by Barsky and Sims (2012), Farmer (2012) and Benhabib and Spiegel (2018), we assume that the relationship between sentiment and economic activity can be asymmetric and nonlinear. Because of this, we adopted the NARDL model by Shin, Yu, and Greenwood-Nimmo (2014). NARDL is an asymmetric extension to the ARDL model (Pesaran & Shin, 1999; Pesaran, Shin, & Smith, 2001), which uses positive and negative partial sum decompositions, allowing the detection of short- and long-term asymmetric impacts. As in the ARDL model, it can be estimated in the presence of variables $I(0)$ and $I(1)$ (Pesaran *et al.*, 2001) and provides efficient results in small samples (Nkoro & Uko, 2016). An optimal level of lags can also be determined for each of the model's variables, and when done properly, it tends to correct possible problems of serial correlation and endogenous regressors (Pesaran & Shin, 1999). To analyze the relationship between sentiment and economic activity, we specify the following model:

$$Ea_t = \alpha_0 + \alpha_1 Sent_t^+ + \alpha_2 Sent_t^- + \alpha_3 Eun_t^+ + \alpha_4 Eun_t^- + e_t \quad (1)$$

In (1) *Ea* is economic activity, *Sent* is sentiment and *Eun* is economic uncertainty; $\alpha = (\alpha_0, \alpha_1, \alpha_2, \alpha_3, \alpha_4)$ is a vector of long-term parameters to be estimated. In equation (1), $sent_t^+$ and $sent_t^-$ represent the partial sums of positive (optimism) and negative (pessimism) changes in sentiment, calculated as follows:

$$Sent_t^+ = \sum_{i=1}^{t} \Delta Sent_t^+ = \sum_{i=1}^{t} \max\ (\Delta Sent_i, 0) \quad (2)$$

$$Sent_t^- = \sum_{i=1}^{t} \Delta Sent_t^- = \sum_{i=1}^{t} \min\ (\Delta Sent_i, 0) \quad (3)$$

| Descriptive statistics | Ea | Sent | Eun | lnEa | lnSent | lnEun |
|---|---|---|---|---|---|---|
| Mean | 93.938 | 96.176 | 108.457 | 1.970 | 1.979 | 2.030 |
| Median | 94.300 | 98.850 | 105.150 | 1.974 | 1.994 | 2.021 |
| Minimum | 60.400 | 57.600 | 85.100 | 1.781 | 1.760 | 1.929 |
| Maximum | 112.600 | 121.200 | 210.500 | 2.051 | 2.083 | 2.323 |
| Standard deviation | 9.901 | 11.995 | 18.465 | 0.047 | 0.058 | 0.064 |
| Skewness | −0.336 | −0.915 | 2.357 | −0.639 | −1.270 | 1.547 |
| Kurtosis | 2.742 | 3.564 | 10.989 | 3.490 | 4.416 | 6.566 |

**Note(s):** The variables are economic activity (Ea), sentiment (Sent) and economic uncertainty (Eun). ln(variable) indicates that the variable is in a natural logarithm. Statistics are based on 168 observations
**Source(s):** Prepared by the authors

**Table 1.** Descriptive statistics (period from January 2007 to December 2020, monthly data)

Similarly, $Eun_t^+$ and $Eun_t^-$ are partial sums of positive and negative changes in economic uncertainty, calculated as follows:

$$Eun_t^+ = \sum_{i=1}^{t} \Delta Eun_t^+ = \sum_{i=0}^{t} \max\ (\Delta Eun_i, 0) \tag{4}$$

$$Eun_t^- = \sum_{i=1}^{t} \Delta Eun_t^- = \sum_{i=1}^{t} \min\ (\Delta Eun_i, 0) \tag{5}$$

In equation (1), $\alpha_1$ and $\alpha_2$ capture the long-term relationship between economic activity and positive and negative changes in sentiment, and $\alpha_3$ and $\alpha_4$ capture the long-term relationship between economic activity and positive and negative changes in economic uncertainty. Equation (1) can be integrated into an ARDL configuration, as follows:

$$\Delta Ea_t = \alpha + \beta_0 Ea_{t-1} + \beta_1 Sent_{t-1}^+ + \beta_2 Sent_{t-1}^- + \beta_3 Eun_{t-1}^+ + \beta_4 Eunt_{t-1}^- + \sum_{i=1}^{p} \varnothing \Delta Ea_{t-1}$$

$$+ \sum\nolimits_{i=0}^{q} \left(y_i^+ \Delta Sent_{t-i}^+ + y_i^- \Delta Sent_{t-i}^-\right) + \sum_{i=0}^{s} \left(\varnothing_i^+ \Delta Eun_{t-1}^+ + \varnothing_i^- \Delta Eun_{t-i}^-\right) \tag{6}$$

In (6), $\Delta$ is the difference operator that captures the short-term dynamics; level variables will capture long-term relationships; $p$ and $q$ are the delay orders; $\alpha_1 = \beta_1/\beta_0$, $\alpha_2 = \beta_2/\beta_0$ are the long-term impacts of increased and decreased sentiment (optimism and pessimism) on economic activity. Similarly, $\alpha_3 = \beta_3/\beta_0$, $\alpha_4 = \beta_4/\beta_0$ are the long-term impacts of economic uncertainty. In this configuration, the short-term asymmetric influences between the variables are captured in addition to the long-term asymmetric relationship. $\sum_{i=1}^{p} y_i^+$ and $\sum_{i=1}^{p} y_i^-$ measure the short-term impacts of increased and decreased sentiment on economic activity, and $\sum_{i=1}^{q} \varnothing_i^+$ and $\sum_{i=1}^{q} \varnothing_i^-$ capture the short-term impacts of economic uncertainty. Equation (6) can be easily transformed into an error correction model with the introduction of the error correction term ($ECT_{-1}$).

To implement the NARDL model, we initially checked the order of integration of the series to ensure that all variables are $I(0)$ or $I(1)$. The presence of variable $I(2)$ makes the F statistics calculated to test cointegration invalid. After confirming the absence of variables $I(2)$ we estimated the model (6) using the standard Ordinary Least Squares method. In this stage of model selection, the length of the ideal delay for each variable is determined by the Akaike information criterion (AIC), and the maximum delay considered was $p = 5$.

Subsequently, we tested the presence of cointegration between the variables using the approach developed by Pesaran *et al.* (2001) and Shin *et al.* (2014). We tested the null hypothesis that $\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$ using the Wald $F$ test and, after confirming the presence of a long-term relationship, we estimate every short- and long-term coefficient. In the last stage, with the presence of cointegration, we derive the asymmetric cumulative dynamic multiplier effects of a 1% increase and 1% reduction in each independent variable over the dependent variable.

The asymmetric cumulative multiplier of the sentiment indicator can be calculated as follows:

$$m_{in}^+(Sent) = \sum_{i=o}^{n} \frac{\partial Ea_{t+i}}{\partial Sent_{it-1}^+}, n = 0, 1, 2, \ldots \tag{7}$$

$$m_{in}^{-}(Sent) = \sum_{i=o}^{n} \frac{\partial Ea_{t+i}}{\partial Sent_{it-1}^{-}}, n = 0, 1, 2, \ldots \quad (8)$$

Similarly, the asymmetric cumulative multiplier of economic uncertainty can be calculated as follows:

$$m_{in}^{+}(Eun) = \sum_{i=o}^{n} \frac{\partial Ea_{t+i}}{\partial Eun_{it-1}^{+}}, n = 0, 1, 2, \ldots \quad (9)$$

$$m_{in}^{-}(Eun) = \sum_{i=o}^{n} \frac{\partial Ea_{t+i}}{\partial Eun_{it-1}^{-}}, n = 0, 1, 2, \ldots \quad (10)$$

## 4. Results and discussions

We initially checked the order of integration of the series to ensure that none of the variables is $I(2)$. For this, we used the ADF and KPSS tests. The ADF test has the null hypothesis ($H_0$) in which the series is non-stationary and integrated in order d (d > 0), $I(1)$ or $I(2)$, against the alternative hypothesis ($H_1$) of stationarity $I(0)$. In the KPSS test, the hypotheses presented contradict the first two, the null hypothesis ($H_0$) postulates that the series is $I(0)$ against the alternative hypothesis ($H_1$) that the series is $I(1)$. Table 2 presents the results of the unit root tests for series in level and in the first difference, and both tests indicate the presence of variables $I(0)$ and $I(1)$, thus justifying the use of the NARDL model.

The result of the long-term nonlinear cointegration test is shown in Table 3 and has an F statistic (F = 11.405) greater than all critical values (10%, 5% and 1%). This result indicates the existence of a long-term relationship between sentiment and economic activity in Brazil. After confirming the presence of long-term cointegration, the regression of equation (6) is

| | ADF (*t-stat*) | | KPSS (LM-*stat*) | |
|---|---|---|---|---|
| | Level | First difference | Level | First difference |
| Ea | −1.218 | −3.205 | 0.666 | 0.025 |
| Sent | −3.120 | – | 0.266 | – |
| Eun | −2.388 | −10.416 | 0.467 | 0.032 |

**Note(s):** The variables are economic activity (Ea), sentiment (Sent) and economic uncertainty (Eun). All variables are in natural logarithms. The appropriate delay length selections in the ADF tests are determined by the AIC. To calculate the bandwidth for the KPSS test, the Andrew Bandwidth procedure was used. All tests are based on 168 observations. Critical values at the 5% level are as follows: ADF 5%, t-calc. = −2.576. 5% KPSS, t-calc. = 0.463
**Source(s):** Prepared by the authors

**Table 2.** Results of the ADF and KPSS test for variables in level and first difference (period from January 2007 to December 2020, monthly data)

| Test statistic | Value | Sig | *I*(0) | *I*(1) |
|---|---|---|---|---|
| F-statistic | 11.405 | 10% | 2.45 | 3.52 |
| | | 5% | 2.86 | 4.01 |
| | | 1% | 3.74 | 5.06 |

**Note(s):** Null Hypothesis: No levels relationship
**Source(s):** Prepared by the authors

**Table 3.** Bounds test for nonlinear cointegration

estimated based on a NARDL (4,5,5,1,3) model automatically chosen from the AIC in a structure with a maximum of five lags.

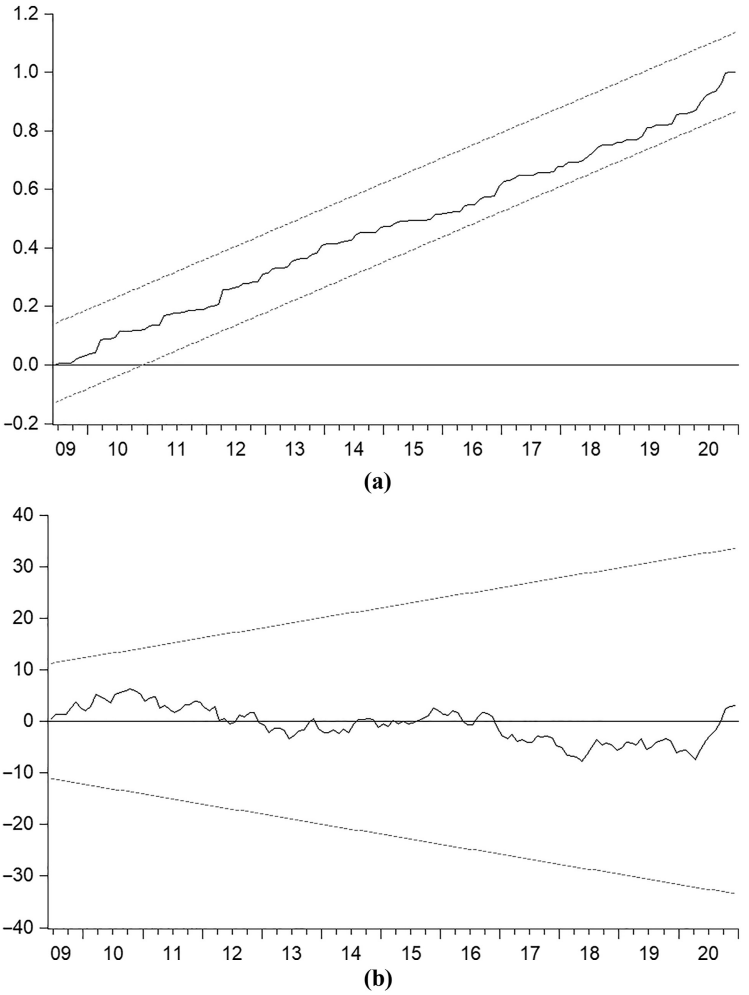
Before analyzing the short- and long-term impacts of positive and negative changes in sentiment on economic activity, we verified the adequacy of the dynamic specification based on various diagnostic statistics. $R^2$ shows that approximately 50% of the variations are comfortably explained by the NARDL (4,5,5,1,3) model. The Breusch–Godfrey test does not reject the null hypothesis of the absence of autocorrelation. The Breusch–Pagan–Godfrey test does not reject the null hypothesis of the absence of heteroscedasticity. The Jarque-Bera test indicates the normality of the residuals and the Ramsey RESET test does not reject the null hypothesis that the polynomial terms do not contribute to the adjustment of the model; therefore, there was no specification error in the regression equation.

Finally, we verify the stability of the model's coefficients using the CUSUM and CUSUMSQ tests that allow observing the constancy of the parameters in a model. The results illustrated in Figure 1 indicate that the null hypothesis of stable coefficients cannot be rejected at the 5% significance level for the CUSUM and CUSUMSQ tests. This indicates that the model is not incorrectly specified and suggests the absence of abrupt structural changes in the model over time. The stability reported by the tests is particularly important because in the analyzed period several events occurred, such as the International Financial Crisis in 2008, the "Operation Car Wash" ("Operação Lava Jato") and the COVID-19 pandemic, whose impact on the variables could cause strong structural breaks that would compromise the validity of the model.

Table 4 shows the nonlinear impacts of sentiment and uncertainty on economic activity. Starting with the long-term impacts of sentiment, we read that its negative partial sum ($Sent_t^-$) is insignificant as opposed to its positive partial sum ($Sent_t^+$). Therefore, the positive and significant long-term coefficient of a positive shock ($Sent_t^+ = 0.307$) shows that a shock of optimism increases economic activity in Brazil. This suggests that sentiment is of vital importance for economic activity, which is consistent with the ideas of Acemoglu and Scott (1994), Lorenzoni (2009), Barsky and Sims (2012) and Angeletos and La'O (2013), who highlight that confidence affects the economy through consumption and investment.

According to Guo and He (2020), when agents feel more optimistic they tend to decrease their preventive savings and become more aggressive in consumption and investment. As a result, the economy improves through optimistic behavior. When market participants are more optimistic about growth, the economy is more likely to experience a boom. Ilut and Saijo (2021) also corroborate this perspective and highlight that consumer confidence is crucial for economic growth and that a lack of confidence can discourage economic activity and lead to recession. This evidence suggests that sentiment can provide relevant information about the current state of economic activity. Governments, monetary authorities and other decision-makers can use these signs of optimism as an evaluative parameter of population satisfaction with the economy and look for strategies to maintain good economic status. From there, they can encourage companies and other market agents to engage in more daring investment projects. Banks and other financial institutions may also reassess their conditions for offering credit.

For economic uncertainty, similar to what occurs with sentiment, a negative partial sum ($Eun_t^-$) is insignificant, unlike the positive partial sum ($Eun_t^+$). This means that the increase in uncertainty reduces economic activity. The negative impacts of uncertainty on economic activity are similar to those reported by Leduc and Liu (2016) in the USA, by Scotti (2016) in the USA, Eurozone, UK, Canada and Japan, by Barboza and Zilberman (2018) in Brazil, among others (Bloom, 2009; Bachmann *et al.*, 2013; Baker *et al.*, 2016; Basu & Bundick, 2017). According to these authors, through several channels, but mainly through investment, an increase in uncertainty negatively affects economic activity.




**Note(s):** The two dotted lines correspond to the critical limits of the test at the 5% significance level

**Source(s):** Prepared by the authors

**Figure 1.**
CUSUM and CUSUM of squares at the 5% significance level

Exploring short-term results and starting with sentiment, we see that positive ($\Delta Sent_t^+ = 0.624$) and negative ($\Delta Sent_t^- = 0.545$) shocks positively impact economic activity. The positive impact of negative shocks is opposite to that expected since these shocks should be harmful and cause contraction in economic activity. We conjecture that these shocks may occur due to the immediacy of information processing. According to several authors, the impact of the sentiment may be opposite to that expected, especially when agents have limited information (Forgas, 1995), low experience (Ottati & Isbell, 1996) or low processing capacity (Greifeneder & Bless, 2007). In addition, Vuchelen (2004) points out that the uncertainty experienced by analysts is transmitted to the sentiment of consumers and investors, especially when the mass media tends to highlight and reinforce the

| | Coefficient | Std. Error | *t*-statistic | Prob |
|---|---|---|---|---|
| C | 1.044 | 0.141 | 7.404 | 0.000 |
| $Ea_{t-1}$ | −0.520 | 0.069 | −7.432 | 0.000 |
| $Sent^{+}_{t-1}$ | 0.159 | 0.059 | 2.706 | 0.007 |
| $Sent^{-}_{t-1}$ | −0.053 | 0.081 | −0.653 | 0.514 |
| $Eun^{+}_{t-1}$ | −0.220 | 0.072 | −3.025 | 0.003 |
| $Eun^{-}_{t-1}$ | −0.009 | 0.083 | −0.115 | 0.908 |
| $\Delta Ea_{t-1}$ | 0.111 | 0.077 | 1.449 | 0.149 |
| $\Delta Ea_{t-2}$ | 0.307 | 0.073 | 4.162 | 0.000 |
| $\Delta Ea_{t-3}$ | 0.292 | 0.073 | 3.976 | 0.000 |
| $\Delta Sent^{+}_{t}$ | 0.624 | 0.194 | 3.209 | 0.001 |
| $\Delta Sent^{+}_{t-1}$ | −0.184 | 0.192 | −0.957 | 0.339 |
| $\Delta Sent^{+}_{t-2}$ | −0.181 | 0.188 | −0.964 | 0.336 |
| $\Delta Sent^{+}_{t-3}$ | −0.366 | 0.187 | −1.959 | 0.052 |
| $\Delta Sent^{+}_{t-4}$ | 0.317 | 0.175 | 1.808 | 0.072 |
| $\Delta Sent^{-}_{t}$ | 0.545 | 0.137 | 3.973 | 0.000 |
| $\Delta Sent^{-}_{t-1}$ | 0.116 | 0.133 | 0.875 | 0.382 |
| $\Delta Sent^{-}_{t-2}$ | −0.046 | 0.134 | −0.349 | 0.727 |
| $\Delta Sent^{-}_{t-3}$ | −0.397 | 0.135 | −2.926 | 0.004 |
| $\Delta Sent^{-}_{t-4}$ | −0.296 | 0.129 | −2.289 | 0.023 |
| $Eun^{+}_{t}$ | 0.132 | 0.104 | 1.267 | 0.207 |
| $Eun^{-}_{t}$ | −0.068 | 0.194 | −0.352 | 0.725 |
| $Eun^{-}_{t-1}$ | 0.471 | 0.171 | 2.741 | 0.006 |
| $Eun^{-}_{t-2}$ | 0.357 | 0.176 | 2.029 | 0.044 |
| Long-run coefficient | | | | |
| $Sent^{+}_{t}$ | 0.307 | 0.110 | 2.774 | 0.006 |
| $Sent^{-}_{t}$ | −0.102 | 0.156 | −0.652 | 0.514 |
| $Eun^{+}_{t}$ | −0.424 | 0.135 | −3.130 | 0.002 |
| $Eun^{-}_{t}$ | −0.018 | 0.160 | −0.115 | 0.908 |

| Diagnostics test | | *t*-statistic | Prob |
|---|---|---|---|
| $R^2 = 0.55$ | Adjusted $R^2 = 0.50$ | – | – |
| Breusch-Pagan-Godfrey Heteroskedasticity Test | | 0.744 | 0.786 |
| Breusch-Godfrey Serial Correlation Test | | 0.254 | 0.775 |
| Jarque-Bera Normality Test | | 5.195 | 0.074 |
| Ramsey RESET Test | | 1.412 | 0.263 |

**Note(s):** The variables are economic activity (Ea), sentiment (Sent) and economic uncertainty (Eun). (+) and (−) indicate the positive and negative partial sums. The NARDL model is estimated based on an automatic ARDL framework designed using optimally chosen AIC-based lags. Δ symbolizes the first difference of the respective variable. The $ECT_{-1}$ coefficient = (−0.520; *p*-value: 0.000) indicates that about 52.00% of errors generated in each period are corrected in subsequent periods (or in the following months). The error correction equation is as follows: $EC = Ea_t - (0.307 * Sent^{+}_{t} - 0.102 * Sent^{-}_{t} - 0.424 * Eun^{+}_{t} - 0.018 * Eun^{-}_{t})$

**Source(s):** Prepared by the authors

**Table 4.** Conditional error correction regression for NARDL model (4, 5, 5, 1, 3)

divergences between future forecasts. The latter case tends to have a self-reinforcing effect when covered with greater prominence in the media (DellaVigna & Pollet, 2009).

The negative impacts of pessimism shocks in the third and fourth lags ($\Delta Sent^{-}_{t-3} = -0.397$ e $\Delta Sent^{-}_{t-4} = -0.296$) are supported in the literature. Ilut and Saijo (2021) indicated that a lack of confidence can discourage economic activities and lead the economy into a recession. Guo and He (2020) highlight that when agents have pessimistic expectations, they can adopt conservative behaviors in consumption and investment, making the economy more sensitive

to changes in confidence. In addition, these negative shocks seem to ratify the idea that only information processed long enough has the expected impact. Knowledge of the impact of these waves of pessimism can be strategically used to avoid delays in important decision-making by companies and other economic agents, such as investment, consumptionand savings, avoiding disinvestment and a possible economic contraction.

The results related to economic uncertainty indicate that in the short term, reductions of up to two past periods ($Eun^{-}_{t-1} = 0.471$ and $Eun^{-}_{t-2} = 0.357$) positively impact economic activity. This implies that a reduction in uncertainty can lead to an increase in economic activity. We also observed that economic activity has some persistence because its lagged values have a positive effect ($\Delta Ea_{t-2} = 0.307$ and $\Delta Ea_{t-3} = 0.292$) on its contemporary value.

The presence of asymmetries between positive and negative shocks of sentiment and uncertainty is verified with the application of the Wald test, and the results are shown in Table 5. The results indicate that the impact of the positive and negative components of sentiment and uncertainty is not the same in the long run, validating the hypothesis of asymmetries. However, in the short term, it was not possible to validate the hypothesis of asymmetries for both variables.

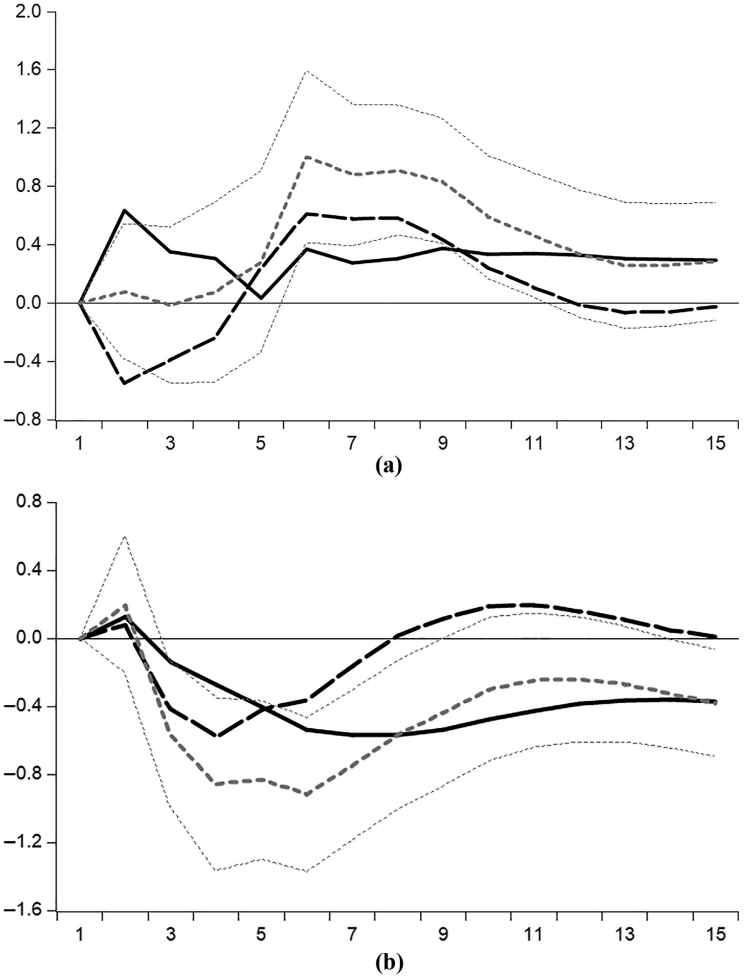
The dynamic multipliers predicted for the nonlinear adjustment of economic activity to the shock in sentiment and uncertainty are shown in Figure 2. These multipliers are estimated based on the NARDL (4,5,5,1,3) model and show the patterns of dynamic asymmetric adjustments in economic activity from its initial equilibrium to the new steady state in the long run, after a unitary shock (negative or positive) of the independent variables. The positive (black line) and negative (black dotted line) change curves show the asymmetric adjustment for positive and negative shocks in a given forecast horizon. The asymmetry curve (gray dotted line) is the linear combination of dynamic multipliers associated with positive and negative shocks, together with their lower and upper bands in the 95% confidence interval.

As for the sentiment (Figure 2a), the dynamic multiplier provides evidence that although positive and negative shocks have a nonlinear impact until the fourth month, the adjustment of these impacts is relatively quick and strong after that period; so, they try to stabilize until the end of the forecast period, positively impacting economic activity. The combined asymmetric effect of a sentiment shock will always affect economic activity in a positive way. As for economic uncertainty (Figure 2b), the adjustment pattern is relatively more complex. The dynamic multiplier indicates that positive and negative shocks have a positive impact until the second month; this reaction is followed by a negative response until the seventh month. The new state of equilibrium is reached after this period and is marked by negative impacts from the positive component. The reverse pattern is observed for the impact of negative variations on economic activity. The combined asymmetric effect of a shock on this variable will be positive only in the initial periods and negative from then on.

| | Long-term asymmetry | | Short-term asymmetry | |
|---|---|---|---|---|
| | $W_{LR}$ | $p$-value | $W_{SR}$ | $p$-value |
| Sentiment | 3.783 | 0.048 | 0.303 | 0.581 |
| Economic uncertainty | 4.410 | 0.035 | 2.574 | 0.108 |

**Note(s):** This table reports the results of the long- and short-term asymmetry tests for the effect of sentiment and economic uncertainty on economic activity. $W_{LR}$ is the Wald statistic for long-term asymmetry, which tests the null hypothesis of $\theta^{+} = \theta^{-}$ for each explanatory variable. $W_{SR}$ is the Wald statistic for short-term asymmetry that tests the null hypothesis that $\pi_i^{+} = \pi_i^{-}$ for each explanatory variable
**Source(s):** Prepared by the authors

**Table 5.**
Asymmetry tests




**Note(s):** The black line shows the positive impact of the independent variable on the dependent variable, while the black dotted line shows the negative impact. The gray line shows the asymmetry. The dotted gray lines show the upper and lower limits of asymmetry at a 95% confidence level

**Source(s):** Prepared by the authors

**Figure 2.**
Dynamic multiplier graph

## 5. Concluding remarks

In this study, we analyze how sentiment affects economic activity in Brazil. We collected monthly data from January 2007 to December 2020 and used a NARDL model to analyze the short- and long-term asymmetric relationship between the variables. There are three main results of this study. First, as seen in previous studies (Lorenzoni, 2009; Barsky & Sims, 2012; Angeletos & La'O, 2013; Mello & Figueiredo, 2017; Ilut & Saijo, 2021; Guo & He, 2020; Kabiri *et al.*, 2022), sentiment is an important factor for economic activity, and its impact possibly occurs through the channels of consumption and investment, which are the two main

components of economic growth (Guo & He, 2020). Second, sentiment impacts economic activity in different ways in the short and long term. This evidence corroborates the propositions of Barsky and Sims (2012) and Benhabib and Spiegel (2018), that economic activity is affected at different speeds by shocks of sentiment. Added to this perspective is the evidence that the signal of the shocks is also important in determining the impact. Third, the effect of shocks of optimism and pessimism on economic activity is asymmetric in the long run, where only shocks of optimism have a significant and positive impact.

The results documented in this study expand the literature and help in understanding the impacts of sentiment on economic activity, a phenomenon that has so far been little explored in Brazil. Regarding previous studies, in addition to corroborating their assumptions, this work promotes a methodological improvement in the estimates made by using an econometric model capable of capturing short- and long-term asymmetric relationships. Considering sentiment as a strong predictor of future recessions (Christiansen *et al.*, 2014), policymakers, governments and monetary authorities can take different measures in response to different changes in this indicator. These agents must monitor sentiment and act immediately during economic downturns or in waves of pessimism since the feedback between the (negative) sentiment and the economic activity can have a great propagation effect in the short term. That is, when economic activity declines, it is essential to restore and increase sentiment, as its absence can further discourage economic activity and lead to a deeper recession (Ilut & Saijo, 2021).

The use of sentiment measures for diagnosing, predicting and signaling the economic trajectory can still be relevant for the design of monetary policies and for decisions on the supply or restriction of credit by financial institutions in periods of instability. Sentiment, therefore, must be included in both short- and long-term economic projects, both from the consumption and investment point of view. It is important to note that these results are limited to the period analyzed and the Brazilian context. Future studies can explore this relationship using the Business Confidence Index also available in Brazil. It would also be very promising to use the same model used in this research in data from other countries. This would be useful for comparing different economies and checking for patterns of response to sentiment shocks. Finally, the relationship between uncertainty and economic activity can be better analyzed in the future, as this was not the focus of this research.

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