

# Mergers and acquisitions in Brazil and economic uncertainty shocks


## Fusões e aquisições no Brasil e choques de incerteza da economia

## Fusiones y adquisiciones en Brasil y choques de incertidumbre económica

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### Abstract:

In this paper, we have analyzed the sensitivity of the aggregate volume of Mergers and Acquisitions (M&A) in Brazil to fluctuations (shocks) in the Economic Uncertainty level from 2010 to 2021 under behavioral and neoclassical theoretical foundations on the M&A causes. We estimated a Vector Autoregressive (VAR) model with the volume of M&A announcements, the Brazil Economic Uncertainty Index (IIE-Br), and microeconomic and market variables. There is evidence that the M&A announcements in Brazil can respond positively to an economic uncertainty shock. Thus, we contribute with empirical evidence to understand the role of macroeconomic factors, including economic uncertainty, in the future conduct of the M&A market.

### Keywords:

macroeconomic factor, vector autorregressive, policy uncertainty, granger causality, M&A waves.

### Resumo:

O objetivo deste artigo foi analisar a sensibilidade do volume agregado de Fusões e Aquisições no Brasil diante de oscilações (choques) no nível de Incerteza Econômica, de 2010 a 2021, sob fundamentos teóricos comportamentais e neoclássicos sobre as causas de M&A. Foi estimado um

modelo de Vetores Autoregressivos (VAR) com o volume de anúncios de M&A, o Indicador de Incerteza da Economia - Brasil (IIE-Br), variáveis macroeconômicas e de mercado. Foram encontradas evidências de que os anúncios de M&A no Brasil podem responder positivamente a um choque de incerteza econômica. Este estudo contribui com evidências empíricas para o entendimento do papel dos fatores macroeconômicos, incluindo a incerteza econômica, na condução futura do mercado de M&A.

#### Palavras-chave:

fatores macroeconômicos, vetores autorregressivos, incerteza política, causalidade de granger, ondas de M&A.

#### Resumen:

El objetivo de este artículo fue analizar la sensibilidad del volumen agregado de fusiones y Adquisiciones en Brasil a las fluctuaciones (shocks) en el nivel de Incertidumbre Económica, de 2010 a 2021, bajo fundamentos teóricos conductuales y neoclásicos sobre las causas de las M&A. Se estimó un modelo de Vector Autoregresivo (VAR) con el volumen de anuncios de M&A, el Indicador de Incertidumbre Económica - Brasil (IIE-Br), variables macroeconómicas y de mercado. Se encontró evidencia de que los anuncios de fusiones y adquisiciones en Brasil pueden responder positivamente a un shock de incertidumbre económica. Este estudio aporta evidencia empírica para la comprensión del papel de los factores macroeconómicos, incluida la incertidumbre económica, en la conducta futura del mercado de M&A.

#### Palabras clave:

factores macroeconómicos, vectores autoregresivos, incertidumbre política, causalidad de granger, olas de M&A.

## 1 INTRODUCTION

Lately, Brazil has been going through a big wave of Mergers and Acquisitions (M&A). According to PricewaterhouseCoopers consultancy, the volume of business announced in the country in 2020 was 48% higher than the previous-five-years average and has grown in 2021 (PricewaterhouseCoopers, 2021b). However, amid such deals, the country is also going through institutional, health and political crises, presenting low economic attractiveness with a reduction in activity level, increased inflation and unemployment, and fiscal imbalance, despite having registered a recovery in 2021 (Souza et al., 2021).

The factors driving M&A waves are not entirely clear, and previous literature has devoted substantial effort to understanding their sources of variation (Boateng et al., 2014; Bonaime et al., 2018). Harford (2005) presents behavioral and neoclassical theoretical foundations on the causes of M&A. The behavioral aspect argues that the M&A waves of firms in the capital market are correlated positively with the bull market (Rhodes-Kropf & Viswanathan, 2004; Shleifer & Vishny, 2003). In this sense, firms have incentives to remain valued and offer their shares as a form of payment in some of these transactions, while undervalued firms are more susceptible to takeovers (Shleifer & Vishny, 2003). On the other hand, the neoclassical strand argues that M&A occur in response to shocks in the economic, technological and regulatory environment, which would provide a large-scale reallocation of assets across sectors of the economy (Harford, 2005). Within this vision, M&E would act as an instrument that facilitates the change to the new institutional environment.

A new stream, more related to the neoclassical approach, explores Economic Policy Uncertainty as a possible source of fluctuations in M&A activities (Bonaime et al., 2018). This uncertainty dimension concerns the unpredictability of the economic policy by government agents, related to who will make the decisions when taken over; and what their future effects on the economy are (Baker et al., 2016). Such uncertainty can change the dynamics of firms' financial decisions, which can delay their investments (Akron et al., 2020; Gulen & Ion, 2015), increase their cash holdings for speculation and precaution (Duong et al., 2020), reduce debt levels (Li & Qiu, 2021), pay more dividends as a form of signaling (Attig et al., 2021) and even reduce earnings management practices depending on their stage in the life cycle (Roma et al., 2020). Specifically, in the case of M&A, empirical evidence for the US suggests that a shock of economic policy uncertainty may negatively affect the volume and value of acquisitions (Bonaime et al., 2018).

More direct testing between these relationships was made possible by the development of a comprehensive uncertainty measure by Baker et al. (2016), the Economic Policy Uncertainty Index (EPU), based on counting the frequency of reports in newspapers that report terms related to political uncertainty. In Brazil, the Brazilian Institute of Economics of the Getúlio Vargas Foundation (FGV/IBRE) calculates and publishes the Brazilian Economic Uncertainty Index (IIE-Br), which is more specific for the Brazilian scenario, with a methodology similar to the EPU, but that seeks to measure the uncertainty of the Brazilian economy (Ferreira et al., 2019).

The uncertainty levels measured by the EPU and IIE-Br have increased since 2015 result of the successive political and economic crises in Brazil. At a global level, the COVID-19 pandemic has raised the uncertainty levels in countries to record levels, which have gradually eased with the advancement of vaccination campaigns. However, in Brazil, such smoothness was more resistant. The calculations of 19 countries' Uncertainty Indexes on a comparable basis reveal that Brazil's level was the second highest after China in April 2021 (Gouveia, 2021). We have selected the IIE-Br as a proxy for uncertainty for this study, as it is more specific to the Brazilian scenario, considering its measurement method, which is more comprehensive concerning the journalistic media sources used, besides considering another component of macroeconomic uncertainty.

Considering the characteristics of the M&A market in Brazil (PricewaterhouseCoopers, 2021b) and the dynamics of macroeconomic and market factors that can generate attractiveness for these operations (Boateng et al., 2014), with particular attention to the economic uncertainty factor (IIE-Br), which has aggravated in the country, we raise the following question: *How does the aggregate level of Mergers and Acquisitions transactions in Brazil respond to economic uncertainty shocks?*

Thus, we aim to analyze the sensitivity of the volume of M&A in Brazil to fluctuations (shocks) in the Economic Uncertainty level from 2010 to 2021. To meet such an objective, we have run a Vector Autoregressive model of the VAR(p) family, which depends on the stationary nature of the time series of the volume of M&A operations, the IIE-Br uncertainty index and the macroeconomic and market variables that possibly present Granger (1969) causality on the level of M&A transactions.

Thus, we contribute to understanding the role of uncertainty and other macroeconomic variables on the companies' economic activities, especially in creating conditions under which investment decisions and corporate acquisitions happen. Furthermore, we contribute to the discussion of the Corporate Finance literature on the role of Economic Uncertainty in financial decisions, which is relatively scarce in Brazil, and specifically, to including these macroeconomic factors as possible drivers of Mergers and Acquisitions waves in the Brazilian market for corporate control.

## 2 THEORETICAL FRAMEWORK

### 2.1 FACTORS DRIVING MERGERS AND ACQUISITIONS

It is well-known that the aggregate M&A level evolves in waveforms (Brealey et al., 2018). According to Brealey et al. (2018), these operations coincide with high quotations of stock prices and can happen for economic reasons regarding deregulation and changes in technology and demand. Furthermore, it is a more frequent trend in sectors undergoing technological or regulatory changes. Brazil, for instance, had its first M&A wave in the late 1990s, driven by factors linked to the liberalization of the economy, with local market deregulation, privatization programs, and international competition associated with technological changes, impacting mainly the energy, telecommunications and banking industries (Wood et al., 2004).

According to Harford (2005), two broad groups classify the explanations for M&A: the neoclassical and the behavioral hypotheses. The Neoclassical ones are associated with economic disturbances leading to industrial reorganization. Technological, regulatory, or economic shocks within an industry lead to firms' asset reallocation inside or outside it. Thus, managers seek to compete for the best combinations of assets generating a wave at that moment. However, the neoclassical hypothesis may be conditioned to capital liquidity in the economy, reflected in how easy one obtains credit, sufficient for the asset reallocation derived from shocks in the industry (Harford, 2005). Accordingly, payments in cash or shares, or a combination of both, will be observed under these conditions. Besides, partial (divisional) cash acquisitions will be more common.

On the other hand, behavioral hypotheses are connected to bull moments in the capital market. In this sense, potential acquirers with overvalued stocks in the market will use them to acquire possible targets with undervalued stocks (Shleifer & Vishny, 2003). Partial and cash acquisitions will be less common. In this sense, waves will occur in the presence of abnormal stock returns or high market-to-book ratios of a sufficient number of companies. Harford (2005) argues that during the M&A wave, from a behavioral perspective, there is no underlying economic rationality in the decisions and no real synergy gains afterward. Therefore, the post-merger firm's performance will also be poor, as the benefits generated may not outweigh the integration costs.

Theoretical streams can help select, understand and interpret the driving factors and contexts in which M&A waves occur. Stock prices, GDP, money supply, exchange rate, interest

rate and inflation are variables having explanatory power over a country's M&A flows (Boateng et al., 2014). Boateng et al. (2014) identified that shocks to such macroeconomic and market factors significantly impact cross-border M&A trends in the UK. The appreciation of the currency and shares in the local capital market positively impacts international M&A. The variation in GDP has a positive influence, while interest rates and inflation seem to affect these activities negatively.

Such proxies were addressed in previous well-established studies investigating the effect of shocks on M&A aggregate volume (Gugler et al., 2012; Ibrahim & Raji, 2018; Kinatader et al., 2017; Rhodes-Kropf & Viswanathan, 2004). However, they are still scarce. Going further in the literature that contributes to the understanding of these factors, Bonaime et al. (2018) proposed the first study that includes the effect of economic policy uncertainty shocks on macro-level M&A activities (considering the aggregate number of announcements in the country). The political environment can lead to risks in the context of M&A, as it can generate uncertainty in target firms' valuation. Such risks are associated with government actions and include changes in tax regulations, government spending, and monetary and exchange rate policies (Bonaime et al., 2018). Besides, the (undefined) behavior of government agents, bureaucracy in public administration and the interest groups' ability to influence policy are factors affecting corporate investment decisions (Xie et al., 2017).

Based on this evidence, Bonaime et al. (2018) quantified the effects of economic policy uncertainty shocks on aggregated volume and value of M&A transactions in American companies. Estimating a Vector Autoregressive (VAR) model focused on M&A activity, the authors identified that political uncertainty, quantified by the EPU, impacts M&A activities negatively, with persistent effects in subsequent months.

Thus, based on theoretical streams to select the factors that drive M&A activities, focusing on Economic Uncertainty as a variable of interest, as it is a more specific index to the Brazilian scenario (Ferreira et al., 2019) and contributing contemporarily to this discussion, we propose the following research hypothesis to be tested and discussed:

**(H1):** *Economic Uncertainty drives the aggregate volume of M&A transactions by companies in Brazil negatively.*

The relationship defined in the hypothesis is based on evidence by Bonaime et al. (2018) concerning the USA M&A market.

### 3 METHODOLOGY

#### 3.1 SAMPLING AND DATA COLLECTION

To achieve the research objective, we verified the effect of shocks of macroeconomic factors on M&A, which included the variable IIE-Br in the model (Bonaime et al., 2018; Boateng et al., 2014). The IIE-Br was the index chosen for modeling, alternatively to the EPU used by Bonaime et al. (2018). The choice is consistent with the IIE-Br measurement method, which includes a journalistic media component with the six largest newspapers of high circulation in the country and an extra component concerning the dispersion of market analysts' forecasts on macroeconomic variables. The Brazil EPU includes only the media component, considering only the newspaper "Folha de São Paulo," which may suffer a perspective bias from this single news source. Furthermore, the IIE-Br economic component may be more responsive to corporate investment and acquisition decisions, justifying the choice of this variable for the model.

The M&A market was analyzed considering the Brazilian companies that made M&A announcements from January 2010 to March 2021. The monthly volume of M&A announcements came from the Mergers and Acquisitions report of the PwC consultancy (PricewaterhouseCoopers, 2021a) until March 2021, which includes operations for the acquisition of controlling and non-controlling interests, mergers, joint ventures, and incorporations of public companies (with shares traded on the stock market) and private equity, involving national (large majority) and foreign capital.

The economic uncertainty variable - IIE-Br by Ferreira et al. (2019) came from the Economic Policy Uncertainty website (policyuncertainty.com) and the representative data on the Brazilian capital market performance (IBOV) from the Economatica® database. Data representing the macroeconomic factors were from the Time Series Management System - SGS of the Brazilian Central Bank (bc.gov.br/sgspub), namely the Economic Activity Index (IBC-Br) and the Selic interest rate. Since this analysis involves monthly modeling, we adopted the IBC-Br instead of GDP as an aggregate indicator of economic activity every month. Figure 1 shows the historical evolution of monthly M&A announcements along with the IIE-Br.

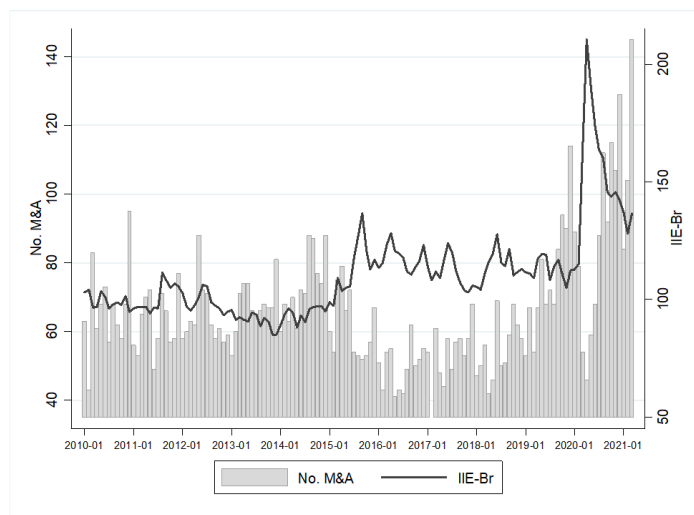


Figure 1

### Historical evolution of the monthly volume of M&A announcements and Economic Uncertainty in Brazil 2010 to 2021\*

Source: Data available at <https://www.pwc.com.br> and <https://www.policyuncertainty.com/>.

Note: No. M&A is the volume of mergers and acquisitions announced monthly, and IIE-Br is the Brazilian Economic Uncertainty Index. \*Until March 2021.

Up to 2015, the M&A announcements fluctuate within a stable range. However, from that year on, the volume displayed a considerable slump over the months. It is noticeable that this downward trend from 2015 coincides with a persistent upward trend in the IIE-Br, increasing and settling around the range of approximately 115 points. This uncertainty increase emerges from the scenario of deterioration in the country's political situation, besides other events such as downgrading Brazil's credit rating by Standard & Poor's (Schymura, 2019), which may have contributed to the slump in M&A announcements, with the discouragement of managers and poor expectations regarding economic conditions. However, from 2019 on, the two series presented their historical peaks. In the case of IIE-Br, its peak was triggered by the COVID-19 crisis in March 2020, which preceded a positive reflection of the M&A wave. This specific moment caused a retraction in M&A, which soon resumed growth in 2020. In March 2021, the series presented its historic peak, with 145 announcements in that month.

### 3.2 VECTOR AUTOREGRESSIVE (VAR) MODELS

The VAR models (or vectors with error correction – VEC, if the original time series are not stationary) are used to model multivariate time series and verify the dynamic effect of a regressed variable with its own lagged values and other variables that can help in this prediction, generating a system of simultaneous equations (Brooks, 2019). Once estimated, we can use either VAR or VEC to simulate the response of any variable in the system in the face of disturbances in the variable itself or other variables in the model (Boateng et al., 2014; Lamounier & Nogueira, 2007).

To clarify the general structure of VAR ( $p$ ), the simplest case to consider is the bivariate VAR of order 1, denoted as VAR(1), which considers in its structure the series  $y_1$  and  $y_2$  ( $k = 2$ ). Thus, we have (Tsay, 2010):

$$y_t = \phi_0 + \Phi y_{t-1} + \epsilon_t \quad (1)$$

Where  $\phi_0$  is a  $k$ -dimensional vector,  $\Phi$  is a  $k \times k$  matrix, and  $\{\epsilon_t\}$  is a multivariate white noise  $k$ -dimensional vector, detailed as follows, considering  $k = 2$ :

$$y_t = \begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix}; \phi_0 = \begin{bmatrix} \phi_{10} \\ \phi_{20} \end{bmatrix}; \quad (2)$$

$$\Phi = \begin{bmatrix} \phi_{11} & \phi_{12} \\ \phi_{21} & \phi_{22} \end{bmatrix}; \epsilon_t = \begin{bmatrix} \epsilon_{1t} \\ \epsilon_{2t} \end{bmatrix}$$

i.e.:

$$\begin{aligned} y_{1t} &= \phi_{10} + \phi_{11}y_{1t-1} + \phi_{12}y_{2t-1} + \epsilon_{1t} \\ y_{2t} &= \phi_{20} + \phi_{21}y_{1t-1} + \phi_{22}y_{2t-1} + \epsilon_{2t} \end{aligned} \quad (3)$$

Where  $\phi_{ij}$  is the element  $(i,j)$  of the matrix  $\phi$  and  $\phi_o$  is the  $i$ th element of  $\phi_o$ . Based on the first equation of Eq. (3),  $\phi_{12}$ , for instance, denotes the linear dependence between  $y_{1t}$  and  $y_{2t-1}$  in the presence of the  $y_{1t-1}$ . Therefore,  $\phi_{12}$  is the conditional effect of  $y_{2t-1}$  on  $y_{1t}$ , given  $y_{1t-1}$ . Thus, if  $y_{1t}$  would not depend on  $y_{2t-1}$ , only on its proper lagged value (Tsay, 2010).

However, the series structure must offer an adequate representation of stationarity, or one may adopt the VEC model instead. It is possible if one concludes that the series  $y_1$  and  $y_2$  are non-stationary but behave as cointegrated.

### 3.3 MODELING STEPS

The time series empirical analysis is done through an iterative process to obtain the most appropriate specification for the model. The preliminary step is the graph inspection. Then, the stationarity of the series must be verified to corroborate and complement the properties identified in the graphic. The series behavior included in the models must be analyzed concerning their means, which must be constant, and their variance and covariance structures must be finite and constant. If stationarity is not verified, one must evaluate the existence of cointegration relationships between the series. Since stationarity or not can strongly influence the properties and behavior of the series, the failure to consider and analyze it can lead to spurious regressions (Brooks, 2019). One can verify the series' stationarity through the so-called unit root tests.

The tests generally used to verify stationarity are the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests (Dickey & Fuller, 1981; Phillips & Perron, 1988). The advantage of the first one is that it incorporates the possibilities of non-stationarity as a function of the deterministic tendency  $\alpha t$ ; that there is a drift, and that also allows one to obtain  $y_t$  by a higher order AR process (Lamounier & Nogueira, 2007). The drawback of the ADF is the assumption that the random error is a white noise ( $\epsilon_t \sim N(0, \sigma^2)$ ) or that it has a constant variance without autocorrelation and with normal distribution. If this is not the case (as it is usually the case with financial series), the PP test will be the most suitable since it makes a non-parametric correction in the ADF, allowing it to be consistent even if  $\epsilon_t$  does not meet the assumptions such as, for instance, of normality (Bueno, 2011).

Once verified the properties of the series regarding their stationarity, in the case of multivariate analysis of time series, one can start with the implementation of the Granger Causality Test (1969) (Lamounier & Nogueira, 2007). The central idea of this test is to assess whether the lags of a variable "x" contributes to a better prediction of the variable "y", and vice versa. When this occurs, it is possible to say that there is causality as defined by Granger of the variable  $x$  on the variable  $y$ , which is a less restrictive causality, implying in an improvement in the ability to predict and not necessarily an actual theoretical causality relationship. Regarding the stationary series  $y_1$  and  $y_2$ , the Granger test would suggest the estimation of the following regressions:

$$y_{1t} = \alpha_0 + \sum_{i=1}^k \alpha_{1j}y_{1t-j} + \sum_{i=1}^k \alpha_{2j}y_{2t-j} + \epsilon_{1t} \quad (4)$$

$$y_{2t} = \beta_0 + \sum_{i=1}^k \beta_{1j}y_{1t-j} + \sum_{i=1}^k \beta_{2j}y_{2t-j} + \epsilon_{2t} \quad (5)$$

Thus, one can reject the null hypothesis concerning absence of causality if one or more coefficients  $\alpha_{2j}$  are statistically different from zero for different lags in equation (4). Thus, one will not reject that the  $y_2$  causes  $y_1$  in Granger's sense. Likewise, if one or more coefficients  $\beta_{2j}$  are statistically different from zero, the  $y_1$  will cause  $y_2$ . This causality can be unidirectional or bidirectional, depending on significant parameters (Lamounier & Nogueira, 2007). In summary, for the series  $y_1$  and  $y_2$ , the following relations can exist:

$y_1 \leftarrow y_2$   $y_2$  causes  $y_1$  in the Granger sense;

$y_2 \leftarrow y_1$   $\Rightarrow y_1$  causes  $y_2$  in the Granger sense;

$y_2 \leftrightarrow y_1$   $\Rightarrow$  bidirectional causality in the Granger sense;

$y_2 - y_1$   $\Rightarrow$  absence of causality in the Granger sense.

The next step is to determine the lag order  $p$  of the model. Fundamental in time series since the definition of the model's functional form depends on the inclusion of lagged terms of the series' variables, which are also predictors of the dependent variable. To assist in such task, some objective procedures can be used to determine whether a lag should be included or not, such as the AIC (*Akaike Information Criterion*) and SBIC (*Schwarz Bayesian Information Criterion*) information criteria (Heij et al., 2004). The idea of the information criterion is to minimize the residual-based function, which is penalized by the increase in the number of regressors (Bueno, 2011). Therefore, a trade-off of parsimonious models in place of models with more parameters in a single criterion is possible. The objective of the tests is the minimization of the information criteria. It is common to use the AIC and SBIC procedures together. While the latter tends to be more rigorous in models with more parameters and tends to choose a more parsimonious model, the former can work better on small samples, and the results are valid for both stationary and integrated processes (Bueno, 2011).

Once the assumptions and diagnostic tests are achieved, the VAR (or VEC) model can be estimated and applied to the analysis of the series of interest in the system or for predictions, if that is one's purpose. We must remember that modeling goes through an iterative process, and its steps do not necessarily follow a chronological order.

### 3.4 IMPULSE RESPONSE FUNCTION

According to Brooks (2019), the Impulse Response Function (IRF) denotes the responsiveness of the variable  $y_t$  concerning shocks in each VAR system variable. The term "shock" characterizes the disturbances (innovations) that have occurred, which are unexpected variations in the  $i$ th variable of a system, represented by the error terms  $\epsilon_k$  in each equation. In practice, it is achieved by expressing a VAR model as a VMA (Vector Moving Average of infinite order) model, given the invertibility property of a stationary VAR( $p$ ) model (Lamounier & Nogueira, 2007).

The impulse response will be expressed by the partial derivative of the variables of the series  $y_{it}$  concerning each error term of the system of equations:  $\frac{\partial y_{it+j}}{\partial \epsilon_{kt}}$  (Brooks, 2019). The calculated coefficients when plotted against  $j = 0, 1, 2, \dots, g$ , characterize the impulse response function and allow us to examine the effect of  $\epsilon_{kt}$  on  $y_{it+j}$  over time (Bueno, 2011).

Given the series are stationary, it is possible to observe that the effect of the shock tends to gradually smooth out until it disperses over time and the series reverts to its mean. Furthermore, according to Brooks (2019), the simulation of the variation of one standard deviation in shocks is also often used instead of one unit variation in practice.

### 3.5 SPECIFICATION OF THE VARIABLES INCLUDED IN THE MODELING

The estimated VAR model uses monthly data from the  $y_t$  vector series (based on Eq. 1), which specifically considers the following variables: (1) the aggregate monthly volume of M&A announcements, measured by the absolute number of deals announced by companies in the Brazilian M&A market, included in PwC's M&A report from 2010 to 2021 (PricewaterhouseCoopers, 2021a); (2) the Brazilian Economy Uncertainty Index - IIE-Br (Ferreira et al., 2019); (3) the Central Bank Economic Activity Index - IBC-Br with seasonally adjusted level (SGS code: 24364); (4) the discrete monthly returns of the Bovespa Index - IBOV, as a performance proxy of the capital market in Brazil; (5) the volatility of monthly IBOV returns, estimated using an ARCH model; (6) Monthly accumulated Selic base interest rate, in annual terms (SGS code: 4189). Such variables were defined based on studies by Bonaime et al. (2018) and Boateng et al. (2014). The results of the implemented modeling are presented below.

## 4 ANALYSIS AND DISCUSSION OF RESULTS

### 4.1 SUMMARY STATISTICS

Table 1 shows the summary statistics of the variables included in the VAR model. The average number of M&A announcements during the analysis period was approximately 66 per month. The announcements standard deviation was nearly 17, analyzed regarding the mean, characterizing a low dispersion in these data, despite the amplitude of the announcements ranging from 35 to 145, the latter being in March 2021 and the former in February 2017, which is included in a period of downturn in the M&A market in Brazil.

Summary statistics of the series included in the modeling

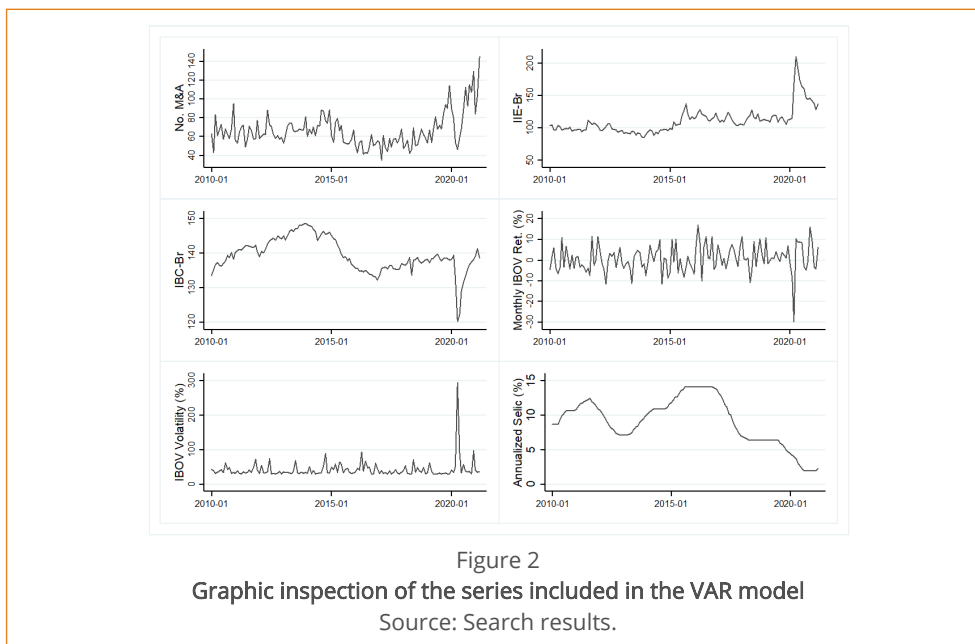
Variable	N	Mean	Median	Stand. Dev.	Asymmetry	Kurtosis	Max.	Min.
No. M&A	135	66.19	62	17.53	1.56	6.61	145	35
IIE-Br	135	110.50	106.30	19.71	2.19	9.58	210.50	85.10
IBC-Br	135	139.35	138.51	4.92	-0.43	4.44	148.59	120.06
IBOV	135	0.61	0.52	6.44	-0.51	5.73	16.97	-29.90
Vol. IBOV	135	41.71	34.67	25.73	7.29	69.60	293.59	29.73
Selic	135	9.09	9.40	3.47	-0.35	2.34	14.15	1.90

Source: Research data.

**Note:** N is the number of observations; No. M&A is the number of M&A announcements in a month; IIE-Br is the Brazilian Economic Uncertainty Index; IBC-Br is the BCB's Index of Economic Activity; IBOV is the monthly percentage return of the Bovespa Index; Vol. IBOV is the percentage volatility of monthly IBOV returns; Selic is the monthly Selic interest rate annualized.

The general analysis of the variables allows verifying the presence of considerable variability in the data, amplitude and behavior in relation to the central tendencies, which contribute to analyzing the effect of these disturbances on M&A announcements.

Figure 2 illustrates the behavior and properties of the series in terms of their variability over the analyzed period. Overall, it is possible to observe an impact on all the series evaluated starting in 2015, more evident for the M&A announcements and the macroeconomic factors IIE-Br, IBC-Br and Selic. The sensitivity of the series concerning events arising from the Brazilian political and economic scenario in this period is perceptible, especially at the beginning of the COVID-19 crisis in March 2020.



Further on, we verified the stationarity condition of the series through the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests. As shown in Table 2, all series were stationary according to the ADF test since the calculated test statistic was higher than the critical value tabulated at the 10% significance level. However, the PP test pointed out that the IBC-Br and Selic series can cause problems regarding their stationarity condition. For this research, we consider that the series are stationary, as pointed out by the ADF test. With this, it is possible to proceed to the analysis of the results of the Granger Causality Tests and the VAR model.

Table 2  
Unit Root Test Statistics

Variable	ADF	PP
M&A	-2.535	-3.966
IIE-Br	-2.969	-3.744
IBC-Br	-2.598	-3.081
IBOV	-9.606	-10.703
Vol. IBOV	-7.743	-9.83
Selic	-2.464	-0.986
Critical Value (10%)	-1.288	-3.145

Source: Research data.

#### 4.2 GRANGER CAUSALITY

The following table presents the results of Granger Causality tests for the variables included in the VAR model. Note that the predictability of the number of M&A announcements was influenced by all the variables considered, adopting a 10% significance level, except for the IBOV returns. This important finding shows that short-term movements in the capital market in Brazil are still not as preponderant for the behavior of the M&A aggregate as they are in developed capital markets (Boateng et al., 2014; Gugler et al., 2012; Rhodes-Kropf & Viswanathan, 2004).

Since a segregated analysis for only a sample of mergers and acquisitions of the largest companies participating in the stock market could likely lead to different results, and our work consists of the analysis of all transactions and not of those publicly traded companies, this analysis remains a suggestion for future research.

Table 3  
Granger Causality test

$H_0$		$H_0$		$H_0$	
M&A is not caused by:	Wald $\chi^2$	IIE-Br is not caused by:	Wald $\chi^2$	IBC-Br is not caused by:	Wald $\chi^2$
IIE-Br	5.228**	M&A	0.553	M&A	2.485
IBC-Br	5.592**	IBC-Br	0.600	IIE-Br	5.537**
IBOV	1.963	IBOV	22.611***	IBOV	14.737***
Vol. IBOV	2.966*	Vol. IBOV	2.751*	Vol. IBOV	1.230
Selic	9.681***	Selic	1.311	Selic	0.977
All	24.173***	All	29.204***	All	25.055***
$H_0$		$H_0$		$H_0$	
IBOV is not caused by:	Wald $\chi^2$	Vol. IBOV is not caused by:	Wald $\chi^2$	Selic is not caused by:	Wald $\chi^2$
M&A	0.687	M&A	2.564	M&A	2.072
IIE-Br	2.136	IIE-Br	14.190***	IIE-Br	0.020
IBC-Br	0.002	IBC-Br	2.692	IBC-Br	8.767***
Vol. IBOV	0.016	IBOV	12.628***	IBOV	0.190
Selic	0.060	Selic	0.091	Vol. IBOV	0.165
All	8.476	All	34.682***	All	34.654***

Source: Research data.

Note: \*\*\*, \*\*, \* rejects the null hypothesis that there is no Granger causality between the variables at the 1%, 5% and 10% levels, respectively.

It is noteworthy that the number of M&A announcements did not show bidirectional causality in terms of the other variables analyzed since we could not reject the null hypothesis that each variable in question is not caused by the number of M&A. However, the analysis of all variables together allows us to infer that their inclusion in the model has the potential to improve the forecast quality regarding the M&A operations.

#### 4.3 VAR MODEL ANALYSIS

The procedures to define the lag order of the model are presented in table 4, using the AIC and SBIC criteria:

Table 4  
VAR model lag order

Lags	LL	LR	df	p	AIC	SBIC
1	-2102.36	1200.7	36	0	33.77	34.71*
2	-2018.25	168.21	36	0	33.01	34.76
3	-1967.84	100.82	36	0	32.78*	35.34
4	-1945.63	44.428	36	0.158	33.00	36.36

Source: Research data

Note: \* indicates which equation had its information criterion minimized.

In table 4, we compare the results between models with various lags, defining the models with up to 4 lags. The asterisk in the AIC and SBIC criteria indicates which equation has the

most consistent number of lags. The models with 3 and 1 lags have their values minimized in both. This definition considered the parsimony principle, and we adopted the result of the SBIC criterion, which is more rigorous, thus following the specification for the one-lag model.

With the application of the VAR model, we achieved the objectives of this research through the analysis of the Impulse Response Function. VAR modeling, which is parameter-intensive, produces extensive reports on the estimated coefficients for the system of equations, which often do not have a direct interpretation (Lamounier & Nogueira, 2007). Thus, the IRF and accumulated IRF graphs analyzed in Figures 3 and 4, respectively, are those that had the variable "number of M&A announcements" as the response variable. Figure 3 shows, for each analyzed relationship, the subsequent effects of shocks and the speed with which they are absorbed over time. In turn, figure 4 helps interpret the impulse effects, accumulating the responses in the period shown in the graph.

Overall, the results do not support the hypothesis that economic uncertainty shocks produce a negative impulse on the volume of M&A announcements in Brazil. The estimation shows that *ceteris paribus*, an IIE-Br shock has a positive and significant effect on the volume of M&A announcements in subsequent months. In figure 3, we can observe that the impulse is upward until the second month and, from there, gradually declines, but with a persistent effect beyond eight months until reaching a steady state.

Accumulating the responses for eight months after the IIE-Br shock (figure 4), the unexpected increase of one unit in this index is associated with an estimated increase of 1.54 announcements over this period. Thus, in the presence of IIE-Br shocks, M&A announcements tend to increase in the short and long term. These results differ from the evidence by Bonaime et al. (2018), who suggested a negative effect on this relationship for the US (however, using an economic policy uncertainty variable).

The economic dynamics of emerging markets, such as Brazil, can address divergent results from the empirical evidence of other more developed markets (Schwarz & Dalmácio, 2020). Furthermore, one of the factors that can encourage M&A, linked to political and institutional reasons, is the mimetic behavior that companies assume when trying to follow each other (Wood et al., 2004), which can be a response to the uncertainty in the environment (DiMaggio & Powell, 1983). This behavior can also be driven by the agency relationship, which leads to an increase in M&A in scenarios of uncertainty (Duchin & Schmidt, 2013). Another possibility of interpretation of these results is that in an environment of higher economic uncertainty, some less capitalized companies may become "cheaper" and inclined to be acquired by firms with greater capacity to face crises and financial difficulties. This situation is very plausible given the nature of market concentration, where Mergers and Acquisitions processes give rise to larger and more solid firms by acquiring their competitors or interrelated firms.

This finding belongs to the neoclassical theoretical current highlighted by Harford (2005), that shocks derived from economic disturbances lead to industrial reorganization through M&A and change to a new environment. The change within this perspective emerges from the money supply in the economy. These conditions were present in the analyzed context shown in figure 2 previously, where the Selic rate had a significant decline from 2016 on. Besides, these results show a negative relationship between the interest rate and the number of M&A. The Brazilian situation in the analyzed period may justify the relation found between the number of announced M&A transactions and the IIE-Br.

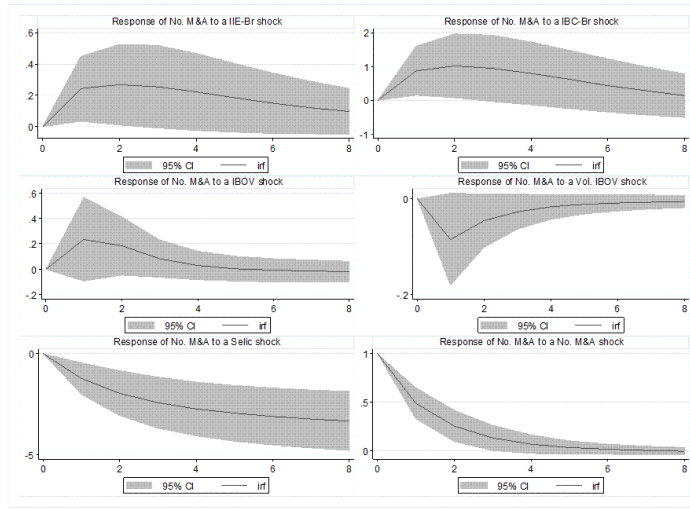


Figure 3  
**Responses of the number of M&A announcements to impulses of economic uncertainty and macroeconomic and market factors**  
 Source: Research data.

We observed that M&A announcements are more responsive to the macroeconomic factors IBC-Br and the Selic rate. A shock to economic activity leads to a persistent increase in M&A in the upcoming months. On the contrary, a shock to the Selic rate generates a negative and persistent effect on M&A.

Accumulating the responses for eight months after an IBC-Br shock (figure 4), the unexpected increase of 1 unit in this index leads to an estimated increase of 5.15 announcements over this period. In the case of the Selic rate, this effect is the opposite and more intense, where the unexpected increase of 1% in this rate leads to an estimated reduction of 21 announcements during the same period. These same relationships were observed by Boateng et al. (2014) in the context of the UK M&A market, corroborating the importance of such macroeconomic factors as drivers of M&A, having similar effects regardless of institutional differences between countries.

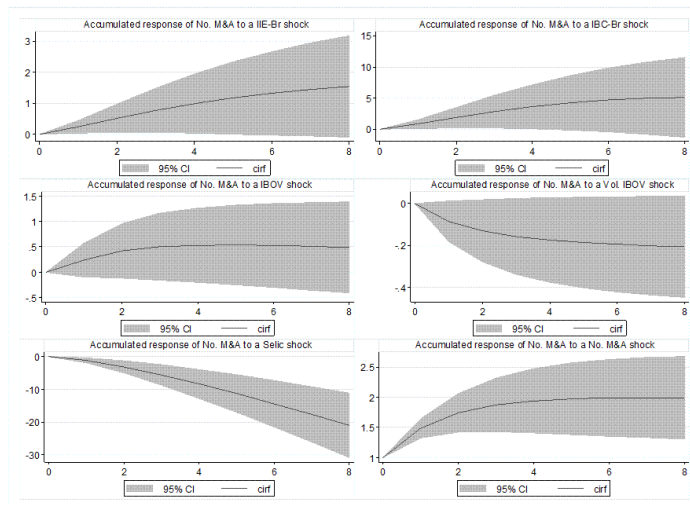


Figure 4  
**Accumulated responses of the number of M&A announcements to impulses of economic uncertainties and macroeconomic and market factors**  
 Source: Research data.

In the case of market factors such as return and volatility of the IBOV, we found that M&A announcements are less responsive to shocks in these variables, which are quickly absorbed in the first few months (figure 3). In the accumulated responses for eight months after the shock of the IBOV returns (figure 4), the unexpected increase of 1% in the monthly return leads to an estimated increase of 0.49 announcements over this period. In the case of volatility, 1% leads to a reduction of 0.20 announcements in approximately eight months. The relationship is consistent with the behavioral perspective that M&A waves are associated with high market moments (Shleifer & Vishny, 2003) but weakly in this context and period analyzed.

for the Brazilian scenario. It is noteworthy that the M&A announcements analyzed are not restricted to publicly traded companies. This fact, besides the developing capital market in Brazil, may have contributed to this weak relationship, unlike in developed countries, as demonstrated by Boateng et al. (2014), where the market variable is one of the most impacting factors.

Finally, the last relationship shown in figures 3 and 4 provides evidence of a mimetic behavior of companies that practice M&A announcements since unexpected increases in their announcements lead to a subsequent increase in their number.

## 5 CONCLUSIONS

This study is the first known to provide evidence of the effect of shocks from macroeconomic factors on future M&A activities in the Brazilian scenario, focusing on the Economic Uncertainty factor. The results provided evidence to reject the research hypothesis that economic uncertainty shocks negatively drive the aggregate volume of M&A transactions of companies in Brazil. In this sense, unexpected increases in Economic Uncertainty may contribute to increased announcements in subsequent months. One possible explanation for these results is that in an environment of higher uncertainty, some less capitalized companies become "cheaper" and prone to be acquired by firms with greater capacity to face crises and financial difficulties. This situation is plausible given the Brazilian economy reality and trend in market concentration through Mergers & Acquisitions, with larger and more solid firms acquiring their competitors and interrelated firms.

Such evidence has greater adherence to the neoclassical assumption in explaining the sources of variation in M&A activity in the case of the Brazilian scenario and period analyzed. We highlight that the neoclassical hypothesis depends on credit availability in the economy, which was present in the analyzed situation reflected in the drop in the Selic rate in recent years.

These findings provide evidence in some aspects of the Brazilian scenario, possibly verifiable in future research: uncertainty triggers a mimetic behavior that encourages managers to follow the leading companies in the industry; M&A is an instrument that facilitates changes in the new institutional environment, reflected in the competitive environment of companies in industries and affected by the economic uncertainty; agency conflicts may be present in this context since uncertainty can lead to irrational decisions by managers who need to stand out at this moment to ensure their stability; bullish moments in the stock market are weakly related to the waves of M&A in Brazil.

Furthermore, new studies can contribute to strengthening this evidence, verifying whether the payments of the deals are predominantly made in cash, thus adhering to the neoclassical hypothesis. Other studies can segregate the deals involving national or international targets (cross-border M&A) and verify the differences in macroeconomic effects and the influence of global economic uncertainty in these negotiations.

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