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The Relationship Between Financial Indicators and Financial Intermediaries' Stock Price Volatility Listed on the BM&FBOVESPA Index in the Crisis Period of 2008 and 2020 (Covid-19)

AREA: 2
TYPE: Application

67

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A relação entre os indicadores financeiros e a volatilidade do preço das ações das intermediadoras financeiras listadas no índice BM&FBOVESPA no período das crises de 2008 e 2020 (Covid-19)
La relación entre indicadores financieros y la volatilidad del precio de las acciones de los intermediarios financieros que listan en el índice BM&FBOVESPA durante el período de la crisis de 2008 y 2020 (Covid-19)

The study goal was to verify the relationship among financial indicators and intermediaries' volatility stock price listed on the BM&FBovespa Index in the crisis period from 2008 and 2020 (COVID-19). The methods used for analysis were Spearman's correlation, multiple linear regression, and Test T. The analyzed period refers to the year 2008, the second semester of 2019 and the first semester of 2020, which include the periods before and during the crises of 2008 and 2020. The results found show that only the indicator of the assets total turnover rate has a significant relationship with the stock price volatility.

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O estudo tem como objetivo verificar a relação entre os indicadores com a volatilidade das ações das intermediadoras financeiras listadas no Índice BM&FBovespa no período das crises de 2008 e 2020 (COVID-19). Os métodos utilizados para análise foram de correlação de Spearman, regressão linear múltipla e Teste T. O período analisado refere-se ao ano de 2008, segundo semestre de 2019 e primeiro semestre de 2020, onde englobam os períodos pré e durante as crises de 2008 e 2020. Os resultados encontrados apontam que apenas o indicador taxa total de rotatividade dos ativos possui relação significativa com a volatilidade do preço das ações.

El estudio tiene como objetivo verificar la relación entre los indicadores y la volatilidad de las acciones de los intermediarios financieros listados en el Índice BM&FBovespa en el período de las crisis de 2008 y 2020 (COVID-19). Los métodos utilizados para el análisis fueron la correlación de Spearman, la regresión lineal múltiple y la prueba T. El período analizado se refiere al año 2008, la segunda mitad de 2019 y la primera mitad de 2020, que incluyen los períodos antes y durante las crisis de 2008 y 2020. Los resultados encontrados indican que solo el indicador de tasa de rotación de activos totales tiene una relación significativa con la volatilidad del precio de las acciones.

1. Introduction

 2020 was a year when the world's leading economies faceed one of the biggest economic crises in recorded history. The global financial instability, resulting from the impact caused by the emergence of an unknown threat to the population health, called COVID-19, generated uncertainty and distress in such a way as to strongly impact the investor sentiment and strategies.

In times of crisis, the consequences of financial difficulties have a great impact on organizations (Upadhyay; Mukherjee; & Panigrahi, 2023), and consequently, influence the financial market. COVID-19 started in China, more specifically in Wuhan, and soon spread throughout the world, in a way that, within a few months, it became characterized as a pandemic. As the pandemic evolved around the world, the main stock exchanges in the financial market had considerable falls.

The financial market volatility is a subject portrayed by several surveys. Internationally, a range of approaches are discussed to identify the impacts on volatility and share prices in times of crisis, including the volume of negotiations (Ozdemir, 2020), investor sentiment, on how regulatory announcements can interfere with market variation (Berk; Rauch, 2016). There are also studies that show the relationship of economic (Chun; Cho; Ryu, 2020) and financial indicators with stock volatility (Jiang et al., 2019).

It is observed that in the face of strong economic instability, it is convenient to investigate factors that can mitigate or reduce the impact of investors portfolios, in the search for portfolio optimization. In this sense, Broto, Díaz-Cassou and Erce (2011) analyzed the determinants of volatility of different types of capital inflows to emerging countries and investigated the causal relationships between the calculated volatility and the explanatory variables by type of flow. Carvalho et al. (2017) investigated the volatility of capital flows and its determinants in Brazil. In this logic, Machado and Faff (2018) analyzed the relationship between asset growth and stock returns in the Brazilian stock market.

Regarding economic and financial indicators as possible predictors of stock price variation, Celebi and Honig (2019) found that macroeconomic indicators significantly impact the German stock market in a period of crisis. In that regard, Sant'Anna et al. (2015) demonstrated a strong relationship between the Price/Book of shares and abnormal results in the Brazilian capital market. Jiang et al. (2019) researched the relationship among the indicators, total asset turnover rate, return on equity, earnings per share, relationship between assets and liabilities and the financial sector volatility in China, however the model presented has as a research gap the temporal issue.

Thus, the financial indicators analysis against volatility is a research area to be explored, especially when evaluating movements in periods of crisis, and considering that no studies were found that verify the relationship of the indicators with the COVID-19 crisis compared to other periods. The sector selected for research is the financial sector, specifically the

financial intermediaries BM&FBOVESPA Financial Index (IFNC), as it is an important investment segment. Therefore, the banking sector becomes increasingly important in the economy (Taha; Alshurafat; Shbail; & Obeid, 2023), and for Mantovani and Santos (2015, p. 509) this occurs "through innovations and mainly by seeking constant increase in profitability".

Banks operate based on expectations for the future, which brings potential instability to the banking business, due to the information asymmetry and the existence of uncertainties related to business conditions throughout the economic cycle that can lead to excessive risk taking and rationing credit due to high default risks (Mantovani; Santos, 2015; Taha; Alshurafat; Shbail; & Obeid, 2023).

Thus, given the above, the following question emerges: What is the relationship of financial indicators with the financial intermediaries' volatility listed on the BM&FBovespa Financial Index in periods of crisis? To answer the proposed question, this research aims to verify the relationship of financial indicators with the financial intermediaries' shares volatility listed on the BM&FBovespa Index in the 2008 and 2020 crises (COVID-19).

The aim of this research is to contribute to the knowledge of the relationship between financial indicators and stock price volatility in periods of turmoil, as in the case of the 2008 and 2020 crises. Thus, is the indicators point to significant correlation on the market volatility in uncertainty periods, such indicators may be investors allies, and thus, they will make the best decisions when faced with financial crisis scenarios, especially for more conservative investors, avoiding financial losses in investment portfolios.

Thus, the research aims to contribute to the literature in a way that complements the study by Sant'Anna et al. (2015), Machado and Faff (2018), Jiang et al. (2019), Celebi and Honig (2019), Ozdemir (2020) and Jebabli, Kouaissah and Arouri (2022), for analyzing and comparing the volatility of the two crises and the relationship of financial performance indicators with the volatility in two of the most critical periods of the economy worldwide (2008 crisis and COVID-19).

2. Literature Revision

Volatility represents the estimate of variation in a variable, with the main characteristic of not being an observable variable (Salisu; Demirer; & Gupta, 2022). In the financial market, volatility portrays the fluctuation of asset prices and denotes an impasse when trying to anticipate their fluctuations (Jebabli; Kouaissah; & Arouri, 2022).

In the field of investments, financial indicators represent an important tool, as, through their representation, they contribute to good decision-making by investors (Dunbar, 2022). Deng, Zhu, Duan, Fu and Liu (2022) highlight that the adoption of effective performance indicators, consistent with shareholder value creation strategies, is essential for the success of organizations.

The 2008 crisis began because of real estate speculation in the United States, caused by an abusive increase in property values, and this fact caused a limitation in the offer of credit, reducing the investment power of companies (Jebabli; Kouaissah; & Arouri, 2022).

For Vikram, Hotwan, and Mohanty (2022), the crisis impacted the investments of companies with financial constraints more sharply compared to unrestricted companies. On the other hand, Driver and Muñoz-Bugarin (2019) pointed out that the financial crisis mainly affected larger companies, which became more sensitive to financial restrictions during the crisis.

In the 2020 crisis, the devastating element was Covid-19, which emerged in China, and the diffusion factor was the freedom of movement of people that spread throughout and the world the contaminating elements of the economic system itself. Therefore, this crisis can be considered unique mainly because its nature is fundamentally due to a public health problem, with economic and social consequences (Jebabli; Kouaissah; & Arouri, 2022, Vikram; Hotwan; & Mohanty, 2022).

2.1. Previous Studies

Jiang et al. (2019) studied the relationship between the financial indicators of total asset turnover rate, return on equity, earnings per share and general indebtedness, with the volatility of the price of shares in the financial sector in China. The results showed that the total asset turnover rate had the greatest impact on the share price increase, among the other indicators.

Sant'Anna et al. (2015) analyzed the relationship between the Price/Book (or Share Price/Equity Value per share) of shares traded on the Stock Exchange and Abnormal Results. It was tested, from two stock portfolios (one with the highest Price/Book and the other with the lowest B/W for each year between 1996 and 2014), whether the companies with the highest B/B would be those companies that generated the greatest abnormal results. The tests indicated that the portfolios with the highest P/B were actually the ones with the highest abnormal results, at least for sixteen of the nineteen years surveyed, since for three years the results could not be considered statistically different at a significance level of five percent.

Several studies aim to understand the volatility of financial assets. Carvalho et al. (2017) analyzed the volatility of capital flows and its determinants in Brazil. Ozdemir (2020) investigated the repercussion of volatility between share prices and trading volume in Turkish markets.

In the study by Carvalho et al. (2017) the periods that were more volatile were those where there was a crisis, mainly from 2008 on (subprime crisis) and from 2010 on (European crisis). Ozdemir (2020) found the existence of bidirectional volatility fluctuations between stock prices and trading volume in the pre- and post-crisis 2008 periods. In the crisis period, there is a unidirectional volatility of stock prices with trading volume. This shows that while stock price volatility affects the lagging trading volume in the crisis period, stock price volatility and trading volume in noncrisis period affect each other.

Celebi and Honig (2019) sought to investigate several factors and economic indicators that impact the performance of the main German stock index, including: GDP, unemployment rate, exports, exchange rate, consumer confidence indicator, among others. The authors concluded that in periods of crisis, the main macroeconomic indicators had a significant impact on the stock market.

It is noteworthy that the financial crisis of 2008 became a favorable event for the development of several studies, especially in relation to the analysis of the efficiency of corporate governance mechanisms. thus Matucheski, Clemente and Sandrini (2009) investigated whether corporate governance is a force to reduce stock volatility in periods of high uncertainty, such as that observed in the 2008 financial crisis. The results found indicate that, in the framework of information asymmetry that characterizes the Brazilian stock market, corporate governance manages to reduce the volatility of share prices in periods of high uncertainty, as occurred in the last four months of 2008. During this period, the share prices of companies that practice corporate governance showed less deviation -standard than those that do not practice, which allows us to conclude that their volatility was lower.

Regarding disclosure levels, Malacrida and Yamamoto (2006) found that companies with a higher level of disclosure have a lower average volatility of stock returns than companies with a lower level of disclosure. Araújo, Camargos and Pinho (2019) found that the non-regular periods of the trading session showed to incorporate relevant information for most of the actions. Furthermore, the models that incorporated the preopening period had a greater impact on the nonregular period as a whole, being more significant for the modeling of conditional volatility.

Jebabli, Kouaissah and Arouri (2022) investigated the repercussions of volatility between energy and stock markets during periods of crisis, the main findings reveal that transmissions of volatilities between these markets during the crisis of the Covid-19 pandemic exceeded those recorded throughout the 2008 global financial crisis.

Vikram, Hotwan and Mohanty (2022) report the importance of estimating volatility in crisis scenarios, i.e. 2008 and 2020, as they claim that the repercussions are occasionally more harmful than the effects of the crisis. For Gao, Ren and Umar (2022) in comparing the impact of COVID-19 on stock market volatility between the US and China, they found that COVID-19 was the main reason for the strong fluctuation of the US stock market, unlike China.

Thus, the following study hypotheses were elaborated:

> *H1: the 2008 and 2020 crises (COVID 19) do not present significant differences in relation to market volatilities.*
>
> *H2: There is a positive relationship between the financial indicators and the volatility of the shares of financial intermediaries listed on the BM&FBovespa Index in the 2008 and 2020 crises (COVID-19), with:*
>   *H2a: the Total Asset Turnover Rate indicator was related to volatility in crisis periods;*
>   *H2b: the Return on Equity indicator was related to volatility in crisis periods;*
>   *H2c: the Earnings per Share indicator was related to volatility in crisis periods;*
>   *H2d: the Ratio between Assets and Liabilities indicator was related to volatility in crisis periods;*
>   *H2e: the Share Price by Book Value indicator was related to volatility in crisis periods.*

In this way, the identification of variables that cause an impact or that may be related to the volatility of the financial market, proves to be relevant, considering that they seek to predict the market's behavior, and thus, contribute to the optimization of investors' resources.

3. Methodology

This research is characterized as an applied one. As for its objectives, it is classified as descriptive. As for the procedures, bibliographical research was used to compose the theoretical and documental references. And, regarding its approach, it is classified as quantitative, as it uses statistical methods to analyze and interpret the results (Kruger & Falcão, 2021).

The variables analyzed are the market volatility and financial indicators as shown in **Table 2**. Due to the research objective which was to verify the relationship of the financial indicators with the market volatility in times of crisis, it was established a 6-month period of precrisis analysis and another 6-month period during the crisis of the main scenarios that occurred in the last two decades in the Brazilian financial market, namely the crises of 2008 and 2020. The postcrisis periods were not analyzed, given that the COVID-19 crisis is still on the way.

3.1. The Research and Data Collection Sample

The research sample totaled in the analysis of 07 institutions listed on the BM&FBOVESPA Financial Index (IFNC) in the sector in which financial intermediaries operate (B3, 2020). The index was selected due to its representativeness in the prices performance of the most traded assets in the financial sector.

The total number of companies that comprise the IFNC portfolio is 10 institutions. However, three financial institutions had to be excluded from the sample for not presenting statements or negotiations listed in B3 in the two comprehensive periods of the research (2008 and 2020), as shown in **Table 1**:

Table 1 - Survey Sample

N.	Name	Year of Published Statements on B3	Desired year 2008-2020
1	BCO ABC Brasil S.A.	2006-2020	selected
2	Bank Inter S.A.	2017-2020	deleted
3	Bank PAN S.A.	2006-2020	selected
4	BCO Estado do Rio Grande do Sul S.A.	1998-2020	selected
5	BCO Bradesco S.A.	1997-2020	selected
6	BCO Brasil S.A.	1997-2020	selected
7	BCO BTG Pactual S.A.	2010-2020	deleted
8	Itausa S.A.	1997-2020	selected
9	Itau Unibanco S.A.	1998-2020	selected
10	BCO Santander (Brasil) S.A.	2005-2020 (stock exchange trading from 2009)	deleted

Source: Prepared by the authors based on information on the B3 website (2020).

Data collection for calculating the financial indicators covered by this study was carried out through the institutions websites through the results center of the investors' relationships webpage. Information from the published financial statements was collected, in particular from the balance sheet and income statement for the quarters before the crisis and after the onset of the 2008 and 2020 crises. Thus, the published statements were compared with the respective following quarters to verify whether the companies' indicators would be related to the period volatility following the publications.

The periods selected for comparability between the financial indicators and the period volatility were as follows: date of publication of the balance sheet (raised financial indicators) compared with the share price volatility from the statements closing period to the date of the next respective period closing. The indicators calculations were carried out based on the statements published by the companies and tabulated in an electronic spreadsheet.

Value date of daily share closing for calculating the volatility for the periods 2019 and 2020 were taken from the Tryd software, and for the period 2008 was taken from the Yahoo Finance page (2020). Data were collected from January 2008 to December 2008 and from July 2019 to June 2020. After extracting the data, the periods volatility calculations were performed using Microsoft Excel.

3.2. Research Construct

The research model used in this study aimed at relating volatility as a function of financial indicators in economic instability periods. Thus, the variables and their metrics were defined as shown in **Table 2**.

Independent variables were selected based on the studies by Sant'Anna et al. (2015) and Jiang et al. (2019), such as: total asset turnover rate, return on equity, earnings per share, ratio between assets and liabilities (or general indebtedness) and share price/book value. As for the shares volatility, the studies by Malacrida and Yamamoto (2006) were used as a reference, which is the study dependent variable.

Table 2 - Research Construct

Variables		Metrics	Authors
Independent variables	Total asset turnover rate	Net Operating Revenue / Average Total Assets	Jiang et al. (2019)
	Return on equity - ROE	Net profit/ Net worth	
	Earnings per share	Profit/Action	
	Relationship between assets and liabilities	Total Liabilities/Total Assets	
	Price/Book	Price per Share/Book Value	Sant'Anna et al. (2015)
Dependent variable	Market volatility	Volatility = DP(R), the stock return (R) is calculated: $Rt = \ln(Pt / Pt-1)$, where: Pt = price on day t; Pt-1= price on day t - 1 and ln= neperian logarithm.	Malacrida and Yamamoto (2006)

Source: The Authors (2020)

The study by Jiang et al. (2019) was taken as a basis, as it researched the relationship among indicators, assets and liabilities in the Chinese financial sector stock market. However, time series was not used. Consequently, the research aims to fill this gap by investigating the relationship of such variables in historical periods. To make the model more robust, the Price/Book used by (Sant'Anna et al., 2015) was implemented. The Share Price by Equity Value indicator depicts the coefficient of value paid for the share compared to its registered balance sheet value, that is, it relates the accepted amount to be paid by the investor in the share acquisition in contrast tiits book value. Very high levels of expectations can be considered a risk factor, especially in crisis scenarios.

For data analysis, Spearman's correlation statistics, multiple linear regression and T-test using Microsoft Excel through the extension Action Stat Pro were used. Spearman's correlation test was selected, considering that the data did not show linearity. Thus, the next section addresses the results analysis and discussion , based on the data collected after submitting them to statistical methods, and presents descriptive analyzes of the data collected.

The general multiple linear regression model of this study is as follows:

$$Y = \beta_0 + \beta_1 * Asset\ Turnover + \beta_2 * Return\ Equity + \beta_3 * Earnings\ per\ Share + \beta_4 * General\ Indebtedness + \beta_5 * Price/Book + \varepsilon_0$$

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## 4. Results Analysis and Discussion

4.1. Descriptive Analysis

The half-yearly data collected referred to the periods Jan-Jun/2008 and Jul-Dec/2008 referring to the 2008 crisis, and Jul-Dec/2019 and Jan-Jun/2020, due to the COVID-19 crisis. Therefore, the pre-crisis period (Jan-Jun/2008 and Jul-Dec/2019) and the crisis period (Jul-Dec/2008 and Jan-Jun/2020) were defined.

The comparisons performed between the pre-crisis and crisis periods regarding the market volatility of the selected sector are presented as shown in **Figures 1 and 2**:

It can be seen in **Figure 1** that the stock price volatility in 2008 in the precrisis period, except for Banco Pan, was considerably higher in 2008 than in 2019. In other words, the stock price had more variation in the 2008 pre-crisis period compared to the same period in 2019. This factor can be explained due to a possible stock exchange financial stability, in the period of 2019, in which the market was optimistic regarding investments in variable income, in such a way that , the year presented positive results in general terms.
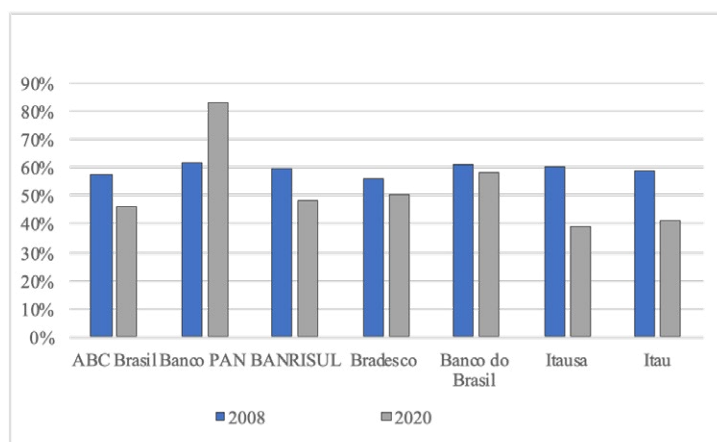
Figure 1 - Pre-Crisis Business Volatility
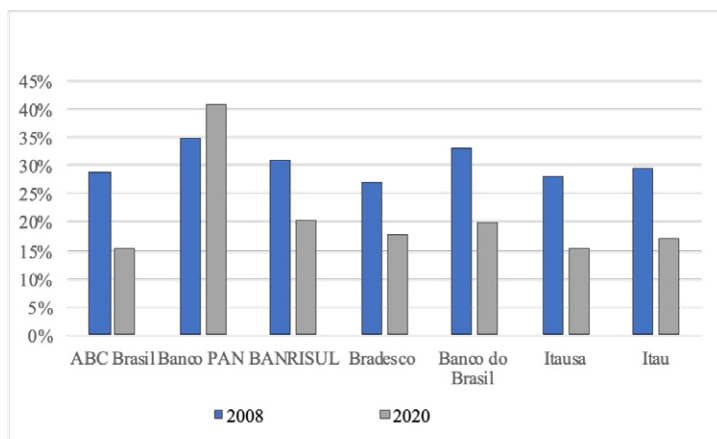
Source: The authors (2020) based on the data collected.

Figure 2 - Crisis Companies Volatility

Source: The authors (2020) based on the data collected.

Regarding the crisis period, **Figure 2** shows that, with the exception of Banco Pan, the 2008 period volatility was higher than in 2020, however, at more similar values than compared to the precrisis period, in such a way that for the 4 companies, the percentages of variations were close.

Thus, in order to compare the means among the periods volatilities, T Test was applied to the sample data, using quarterly data from the pre-crisis and crisis period, to verify whether the averages are statistically different, or can be considered equal.

The Relationship Between Financial Indicators and Financial Intermediaries' Stock Price Volatility Listed on the BM&FBOVESPA Index in the Crisis Period of 2008 and 2020 (Covid-19)

76

Table 3 - Paired T Test

Results	
T-statistics	1,3026
Degrees of Freedom	27
P-value	0,2037
Volatility_2008 Mean	0,3030
Volatility_2020 Mean	0,254
Standard deviation of the differences	0,200
Sample Size	28
Alternative hypothesis other than	0,000
Confidence Level	0,950
Lower Limit	-0,0283
Upper Limit	0,1269

Source: The authors (2020) based on the data collected.
*Note: *p<0.1; ** p<0.05; ***p<0.01*

As seen in **Table 3**, the test presents as result the p-value > 0.05, thus, the *H1* is not rejected, which in the case of paired means tests, the *H1* portrays that the means of the periods are considered equal. Thus, it is possible to assess, at a level of 95%, that the volatility means of the analyzed periods are not statistically different, with no statistically significant differences between the two volatilities (2008 and 2020).

4.2. Data Analysis

After collecting the data through the financial statements published by the respective companies, the information was tabulated through an electronic spreadsheet, so that the periods volatility and the financial indicators were calculated: total asset turnover rate, return on equity, earnings per share, asset-liability ratio, price per share/book value.

With the calculated variables, Spearman's correlation test was applied, considering that the variables are quantitative, and that the data do not present linearity with each other. For the purposes of calculating the correlation, a significance level of 5% was established, that is, a 95% confidence level.

Table 4 presents the results of the test carried out regarding the relation of indicators for the 2008 crisis, based on the pre-crisis and crisis periods:

By analyzing **Table 4**, it is possible to verify that the indicators return on equity, earnings per share, ratio between assets and liabilities, and price per share/book price have p-value > 0.05, thus, there is no significant correlation with volatility. However, the total asset turnover rate had a p-value <0.05, and hence, it is possible to infer at a 5% significance level that the total asset turnover rate has a significant relationship with volatility, in similarity with the studies by Jiang et al. (2019) that also identified this indicator as a significant variable with the increase in stock prices.

Table 4 - P-Values Matrix - Spearman Crisis Correlation Test 2008

P-Values Matrix						
	Total Asset Turnover Rate	Return on Equity - ROE	Earnings per Share	Relation between Assets and Liabilities End General	Price_Book	Volatility
Total Asset Turnover Rate	1	0,4246	0,2882	0,2729	0,1217	0,0491**
Return on Equity - ROE	0,4246	1	0,0000***	0,6871	0,4462	0,0601*
Earnings per Share	0,2882	0,0000***	1	0,6810	0,1905	0,2510
Relation between Assets and Liabilities End General	0,2729	0,6871	0,6810	1	0,1380	0,5588
Price_Book	0,1217	0,4462	0,1905	0,1380	1	0,4165
Volatility	0,0491**	0,0601*	0,2510	0,5588	0,4165	1

Source: The authors (2020) based on the data collected.
*Note: *p<0.1; ** p<0.05; ***p<0.01*

For the analysis period concerning the 2020 crisis, the correlation results are presented in **Table 5**:

Table 5 - P-Values Matrix - Spearman Crisis 2020 Correlation Test

P-Values Matrix						
	Total Asset Turnover Rate	Return on Equity - ROE	Earnings per Share	Relation between Assets and Liabilities End General	Price_Book	Volatility
Total Asset Turnover Rate	1	0,9412	0,7037	0,7287	0,9124	0,0007***
Return on Equity - ROE	0,9412	1	0,0000***	0,9169	0,0814*	0,5859
Earnings per Share	0,7037	0,0000***	1	0,0400**	0,6010	0,7810
Relation between Assets and Liabilities End General	0,7287	0,9169	0,0400**	1	0,2947	0,8617
Price_Book	0,9124	0,0814*	0,6010	0,2947	1	0,7514
Volatility	0,0007***	0,5859	0,7810	0,8617	0,7514	1

Source: The authors (2020) based on the data collected.
*Note: *p<0.1; ** p<0.05; ***p<0.01*

It can be seen in **Table 5** that, similar to the period of 2008, the indicators return on equity, earnings per share, ratio between assets and liabilities, and price per share/book price have p-value > 0.05, therefore, it has no significant correlation with volatility. However, the total asset turnover rate for the period had a p-value <0.05, and consequently, it is possible to infer at a 5% significance level that the total asset turnover rate has a significant relationship with volatility in periods of crisis, again in accordance with the studies by Jiang et al. (2019) who verified this indicator as having an impact compared to the increase in the shares value.

To verify in detail in which period the indicators were significantly correlated with volatility, a correlation analysis was carried out between the independent variables and the dependent variable for the pre-crisis, crisis and post-crisis periods, segmented into quarters, semesters and year.

Table 6 - Correlated Indicators Segregated by Periods

Period	Quarter			Semester		Annual
	Pre-crisis	Crisis	Post-crisis	Pre-crisis	Crisis	
2008	No	No	Relationship between Assets and Liabilities	No	Total Asset Turnover Rate	Total Asset Turnover Rate
2019/2020	No	No	No	Total Asset Turnover Rate	Return on Equity	Total Asset Turnover Rate

Source: The authors (2020) based on the data collected.

It is observed that in the periods in which there was a correlation among the variables, only a single indicator was significantly correlated with volatility. Therefore, it is noted that total asset turnover was the only one of the five indicators that was most frequently correlated with volatility. It is noteworthy that only in the semester of the crisis and annual there was the presence of correlation for the two years of analysis.

Then, multiple regression was performed with a significance level of 95%, with the sole purpose of validating the results presented in the correlation, as in none of the periods there was another indicator significantly related to volatility, it is expected as a consequence that the most correlated indicator also has the greatest influence on volatility, since in the regression the coefficient of this variable will obtain greater weight.

According to **Table 7**, for the 2008 crisis, the research regression model presented a low coefficient of determination. Therefore, the data are not close to the fitted regression line, that is, the model does not accurately explain the response data variability around its mean.

Table 7 - Crisis 2008 Linear Regression Model

	Coefficients			
Predictor	Estimate	Standard Deviation	T-statistics	P-value
Intercept	0,003060196	0,208497643	0,014677367	0,988421869
Total asset turnover rate	0,436141768	0,282934007	1,541496456	0,137458108
Return on Equity ROE	0,057914802	0,655838394	0,0883065513	0,930431984
Earnings per Share	0,032683481	0,061361018	0,53264243	0,599620424
Relation between Assets and Liabilities end General	0,319840012	0,201665375	1,585993688	0,127010797
Price_Book	-0,066327602	0,049480323	-1,340484423	0,193767449
Descriptive measure of fit quality				
Standard deviation of the residuals	Degrees of freedom	R^2	R^2 set	
0,138087274	22	0,196570336	0,013972685	

Source: The authors (2020) based on the data collected.
*Note: *p<0.1; ** p<0.05; ***p<0.01*

As shown in **table 8**, the data regarding the 2020 crisis regression model presented a coefficient of determination higher than that of 2008, but not enough to be considered a strong correlation coefficient. Therefore, the data are not close to the fitted regression line, that is, the model does not accurately explain the response data variability around its mean.

Table 8 - Crisis 2020 Linear Regression Model

	Coefficients			
Predictor	Estimate	Standard Deviation	T-statistics	P-value
Intercept	-0,024805968	0,115710794	-0,214379032	0,832226103
Total asset turnover rate	1,171725471	0,371149796	3,15701499	0,0045717***
Return on Equity ROE	0,864297688	0,824856769	1,047815475	0,306099383
Earnings per Share	-0,00158532	0,030482668	-0,055287798	0,956408217
Relation between Assets and Liabilities end General	0,083004557	0,110103059	0,753880565	0,458914299
Price_Book	0,021041336	0,049087373	0,428650681	0,672345341
Descriptive measure of fit quality				
Standard deviation of the residuals	Degrees of freedom	R^2	R^2 set	
0,124630504	22	0,416876024	0,284347847	

Source: The authors (2020) based on the data collected.
*Note: *p<0.1; ** p<0.05; ***p<0.01*

It is concluded that for the companies in the study, through correlation and regression analysis, it was found that the total asset turnover rate correlated with volatility at the 0.01 significance level, accepting *H2a*. However, the integral *H2* cannot be accepted, as its impact cannot be established, given that the other indicators do not have a significant relationship with volatility, thus rejecting the sub-hypotheses *H2b, H2c, H2d* and *H2e*.

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5. Final Considerations

This study aimed to verify the relationship of financial indicators (Total Asset Turnover Rate, Return on Equity, Earnings per Share, Ratio between Assets and Liabilities, and Share Price by Book Value) with the financial intermediaries' shares volatility listed on the BM&FBovespa Index in the 2008 and 2020 crises (COVID-19). For this purpose, Spearman's correlation, statistical tests, T-test, multiple linear regression and descriptive analysis were performed.

From the results presented, and in response to the research question about the relationship of financial indicators with the financial intermediaries' volatility listed in the BM&FBOVESPA Financial Index in the 2008 and 2020 crises (COVID-19), it is concluded that the indicator rates total asset turnover, showed a significant relationship with volatility at a 5% significance level in the periods analyzed. As for the indicators, return on equity, earnings per share, ratio between assets and liabilities, price per share/book value, the results showed that there is no significant relationship with the sector volatility in question.

Thus, this study contributed to the literature, considering that it aimed at investigating the financial indicators relationship against strong stock price variations caused by the 2008 and 2020 crises, demonstrating that the selected financial indicators are not reliable measurers of relationship with volatility in times of crisis, except for the asset turnover rate, which showed significance.

As research limitations, there is the sample size, which, according to the criteria established and mentioned above, remained in only seven companies, which may have influenced the statistical analyses results. Another restriction concerns the existence of other variables that influence the market volatility. It is also noteworthy that forecasting market behavior is a complex task, as several intrinsic factors may be associated with this variable, such as governance, investor sentiment, among others, in addition to financial indicators, which were the focus of the present study.

For future research, it is suggested to evaluate the relationship of other variables such as corporate governance compared to the behavior in the 2020 crisis and compare them to previous crises, or even have the analysis of other sectors to verify whether the results will be congruent with the findings in the present study.

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