

Evidence of the adaptive market hypothesis in shares traded by B3 listed banking companies

Adaptive market hypothesis in B3 companies

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Abstract

Purpose – The authors aim to verify the indicators that influence the efficiency reported by Brazilian listed financial companies.

Design/methodology/approach – The sample consists of companies in the financial segment that have shares traded in B3, comprising nine institutions from 2000 to 2018 were selected. The authors adopted the regression model with unbalanced panel data to analyze the data. The dependent is the efficiency, which the authors calculated using Hurst Exponent. As independent variables, we used the sector-specific indicators: earnings management, banking resilience, management efficiency, and profitability. The authors controlled the models by size and type of control.

Findings – The findings indicate that the efficiency of financial companies' securities is affected by aspects related to management, resilience, and efficiency in administration. The lower the earnings management, the greater the banking resilience, the efficiency in the management of resources, and the efficiency of stock prices of these companies. These results show that efficiency is affected by intrinsic factors of the entities, corroborating the hypothesis that markets adapt, among others, to institutional factors.

Originality/value – Many users of financial institutions understand whether their stock prices reflect the information provided by accounting. The findings are original because they provide evidence that institutional factors affect the efficiency of companies in the Brazilian financial segment.

Keywords Adaptive market hypothesis, Market efficiency, Securities trading, Banks

Paper type Research paper

1. Introduction

The financial segment has specificities in its operations, concerning structure and business, making companies stand out from the rest. The primary function of these companies consists of intermediating resources between deficit and surplus agents, making this financial intermediary central in the economic flow of society.

There is evidence of market concentration in a few financial institutions in the Brazilian market, and this is because several mergers have occurred in this segment (Azevedo and Gartner, 2020). This fact occurred through the sale of public banks, the merger between institutions, the closure of subsidiaries of foreign banks, and the sale of medium-sized banks.

There are questions about the high profitability of companies in Brazil's financial system, based on high interest rates and bank fees, which generate economic distortions for other sectors that depend on financial entities. Moreover, the sector's inefficiency is associated with technical and administrative problems, not the return of scale; this means that the largest banks are not always more efficient (Henriques *et al.*, 2018).

Specific aspects of this sector may be analyzed to the efficiency levels of securities prices traded on the capital market. As Charles *et al.* (2012) point out, efficiency in predicting a return



on traded assets can appear cyclically, changing from time to time. This fact provides evidence that markets adapt to several factors, such as changes in their conditions, limited rationality of agents, and institutional factors.

Further research must understand this phenomenon more significantly and understand the paradigm that markets are adaptive in influencing price efficiency (Lo, 2004). Thus, the Adaptive Markets Hypothesis (AMH) predicts that several factors may reflect the prices of assets traded in capital markets, including institutional factors (Kim *et al.*, 2011).

The quality of the information provided by banking sector entities is one of the pillars of the financial system since the indicators published by these institutions must adequately demonstrate the economic, financial, and asset situation for their users. It is thus understandable that the lack of quality in the information provided by financial companies generates higher costs and a more significant deficiency in making investments (Bushman and Smith, 2006).

Therefore, given the sector's characteristics, aspects related to information quality, such as earnings management, banking resilience, management efficiency, and profitability, may influence the pricing of banking companies' assets in the Brazilian market.

It is relevant to understand aspects related to specific accounting indicators of the financial sector, given its importance to the Brazilian economy. Many are the users of these institutions, making it helpful to understand whether the price of shares traded in the market reflects the information provided by accounting, indicating that they are mainly essential for their investors. The results contribute to the literature on adaptive markets by providing more evidence of institutional factors affecting corporate efficiency levels. It also contributes to users who need information for their decisions.

This study has four more sections, in addition to this introduction. The first one, the theoretical framework addresses aspects of the financial sector, the efficiency and adaptability of traded assets, and the design of assumptions. The second one has the methodology and provides sample selection criteria, variables, and statistical models. Third, the results present the findings of the study and other validation tests. The final considerations provide the main research implications, limitations, and suggestions for future studies.

2. Background

2.1 *Aspects of the Brazilian financial sector*

The financial sector has different characteristics from other sectors, as intermediating funds among investors and borrowers place these institutions at the center of the economic flow of a given society.

The concern about the regulation of the global financial system has become constant after severe global economic crises involving financial institutions, as in the case of the subprime credit crisis in 2008 (Bell and Hindmoor, 2018). In addition, after bank failures from the 2008 financial crisis, mainly in the United States and Europe, there was a more significant concern to ensure the sustainability of banks to avoid negative consequences for intermediaries belonging to that financial system.

The Brazilian financial sector has undergone several transformations over the last few years after the Real Plan implementation. In other words, increased concentration degree the critical reduction of public banks, number of banks reduction, foreign banks increased participation and other factors that changed structurally this sector (Azevedo and Gartner, 2020). Many of the changes that have taken place in the sector come from the transition from high to low inflation in Brazil, leading to greater efficiency in financial intermediation and in generating results, with positive repercussions on the profitability levels of the banking sector.

The various mergers and incorporations that have taken place in the Brazilian banking system were intended to generate greater solidity in financial institutions. Therefore, market concentration in the financial system can generate positive effects by increasing the quality of services provided, increasing efficiency in the sector, rigidity, and more financial stability. However, in a more competitive sector, more substantial organizations tend to survive, making it necessary for the managers of these companies to achieve greater business efficiency and profitability. Therefore, it is noticeable that competition in the sector becomes desirable because it generates greater informational efficiency, lower costs for customers, and better-quality services.

Another characteristic would be the high profitability of banks, which results in economic distortions for the productive sector through high interest rates and disproportional fees. Nevertheless, there is a high tax burden, risk of default, and administrative cost, which we need to consider.

2.2 Efficiency and adaptability in capital markets

In an ideal capital market, securities prices provide accurate signals for allocating resources from agents who trade in this economy. The central feature of capital markets is the efficiency of a market, representing the relationship between securities prices and availability information.

In an efficient market, securities' prices incorporate the information in, and systematic profits cannot be obtained, for example, through graphical analysis, based on historical quotes and volumes. This scenario is the Efficient Market Hypothesis (EMH), developed by Fama (1965), which predicts that the prices of assets traded in a market reflect the available and relevant information.

According to Fama (1970), EMH indicates that securities prices fully reflect information, quickly incorporating it. The arrival of new information in an efficient capital market reflects instantly on the securities prices, which contain this information at any time (Hiremath and Kumari, 2014). For Beaver (1998), the market is efficient if bond prices act as if everyone were watching the signals of this information system. For Kim *et al.* (2011), information is reflected in asset prices in an efficient market so that no market participant can make abnormal profits. Also, Lo (2005) comments that in an efficient market, prices incorporate information rationally. However, there is a hypothesis that markets are not fully efficient, i.e. it becomes possible for some market participants to make gains systematically (Dourado and Tabak, 2014).

However, market efficiency may not be constant over time. In this case, market participants present a series of deviations in their rationality through specific behavioral biases, which appear to be omnipresent in human decision-making in uncertain environments, leading to undesirable outcomes (Lo, 2005). Fama (1991) comments that in the capital markets, aspects such as the possibility of abnormal returns, limited rationality of market agents, trading costs, among other information, create the hypothesis that the market is always efficient to be invalidated.

Behavioral economists believe that the structure of EMH cannot explain why market efficiency varies over time, and changes can influence that market efficiency in market conditions, the number of competitors, investor composition, investment opportunities, and the risk-reward ratio (Khuntia and Pattanayak, 2018).

Considering this idea that markets are not continuously efficient, behavioral economics has increasingly challenged EMH by arguing that market agents are subject to cognitive biases that affect their rationality (Neely *et al.*, 2009). Thus, a derivation of efficiency emerges through the Adaptive Markets Hypothesis (AMH), proposed by Lo (2004).

The idea that markets are adaptive is based on evolutionary principles and provides a reconciliation of market efficiency with the limited rationality of agents (Lo, 2005). Thus, as

Charles *et al.* (2012) have pointed out, the AMH foresees that the returns of asset predictability may emerge from time to time through changes in market conditions and institutional factors. Lo (2004) defends that behavioral aspects affect market efficiency, as loss aversion, overconfidence, overreaction, among other biases, are in line with an evolutionary model, where individuals adapt to a constantly changing environment. Agents participating in the market are subject to cognitive biases that affect their rationality (Neely *et al.*, 2009). Under AHM, individuals act out of self-interest and make mistakes; but they learn from these mistakes and adapt, driving competition and innovation (Urquhart and McGroarty, 2016).

As evidence accumulated against the efficient market, academics began to explore alternatives to this model. One of the options is to understand that agents are subject to cognitive biases that affect their rationality (Neely *et al.*, 2009).

For AMH, market predictability is presented cyclically, with periods of greater and lesser predictability. Todea *et al.* (2009) point out that the degree of market efficiency varies cyclically over time, and these characteristics are in line with AMH.

Economic agents have limited rationality, i.e. they have restrictions on the information available, the time to act, and their cognitive capacity; thus providing satisfactory rather than optimal behavior (Dourado and Tabak, 2014). An important implication of AMH is that individual and institutional risk preferences change over time, thus, the risk premiums of traded assets also change over time (Tripathi *et al.*, 2020).

In summary, the AMH consists of the following ideas, as presented in Lo (2005, p. 18): “(A1) Individuals act in their interest. (A2) Individuals make mistakes. (A3) Individuals learn and adapt. (A4) Competition drives adaptation and innovation. (A5). Natural selection shapes market ecology. (A6) Evolution determines market dynamics”.

According to Dhankar and Shankar (2016), there are several practical implications of AMH, namely: there is a dynamic risk-reward relationship that depends on the preferences of market participants; market efficiency is not a stable state; arbitrage opportunities exist from time to time and decrease as investors exploit them, and the non-periodic cyclical profitability of investment strategies suggests that a given strategy would perform well in one environment and perform poorly in another.

Therefore, the two implications, according to Kim *et al.* (2011), for market efficiency and adaptability are: it is not an all or nothing condition, but it is a characteristic that varies continuously over time; it is context-dependent, i.e. it is determined by market conditions, institutional factors, and behavioral aspects of its agents.

2.3 Management, resilience, efficiency, and profitability – research assumptions

The literature on the financial sector presents an unavoidable misalignment regarding the most relevant aspects of greater bank efficiency. This section outlines research hypotheses related to the quality of information, banking resilience, resource efficiency, and profitability presented by these institutions and how they perceive these aspects.

As presented, the markets do not present constant efficiency, so one may expect that the assets traded in these capital markets also present cyclical efficiency (Lo, 2004, 2005). Therefore, the banking analysis will be carried out together with the efficiency reported by the assets traded by companies in the market.

The quality of accounting information is one of the pillars of a financial system since the statements, indicators, and reports must adequately show these companies' economic, financial, and asset situations. Therefore, the lack of quality in the information reported by a company generates higher agency and capital costs and more outstanding deficiencies in the investments and allocation of resources of a financial entity (Bushman and Smith, 2006).

Among the various metrics used to measure the quality of the information in accounting, it widely used earnings management to represent the low quality of accounting profits.

However, [Alhadab and Al-Own \(2019\)](#) point out that earnings management may be more accurately measured by using provisions with bank loans in the banking sector.

Brazilian banks have widely used loan-loss provisions as an earnings management tool ([Dantas et al., 2013](#)). However, for [Alhadab and Al-Own \(2019\)](#), managers of European banks with capital incentives manage results by reducing the use of these provisions. Thus, managers use the discretion of this account to leverage or disguise the value obtained by companies by managing the results presented. As the literature perceives earnings management as a low-quality attribute of reported profits, the first research hypothesis follows:

H1. Financial institutions with higher rates of earnings management are less efficient.

Brazilian financial institutions have a capital index established to represent their resilience or stability. For example, the Basel Index, which is the ratio of reference assets to the risk-weighted assets of financial entities, represents an attribute of banking resilience, i.e. the higher this index, the greater the financial stability of a bank ([Pinheiro et al., 2015](#)). Therefore, we expect the higher the index, the greater the resilience of the financial institution, representing a positive aspect to these entities. Thus, the second research hypothesis follows:

H2. Financial institutions with higher banking resilience indexes have higher efficiency.

The efficiency in managing the resources of a financial institution is necessary for business. Greater efficiency in the financial sector can contribute to the greater financial stability of entities. We expect the market to perceive the efficiency in the company's management as it reflects on the asset's efficiency levels. Therefore, the third research hypothesis follows:

H3. Financial institutions with higher levels of efficiency in the management of resources are more efficient.

The profitability of companies represents the relationship between profit and the investment made by them. The higher the business's profitability, the more comfort managers have, since there is an increased propensity to pay and amounts of dividends provided to shareholders ([DeAngelo et al., 2006](#)). Among the indicators, the return on equity represents the company's final result, which will remunerate the equity invested; in other words, it measures the return on the resources invested by the owners of the entity. Given the character of this index, we expected that the highest profitability is a positive attribute to the business, so the fourth hypothesis is:

H4. Financial institutions with higher profitability rates have more efficiency.

We assume that banks do not show constant efficiency through the four hypotheses outlined above, and this efficiency may be affected by institutional factors. This argument is in line with [Charles et al. \(2012\)](#), who stated that the predictability of returns emerges cyclically, based on changes in market conditions and institutional factors. Thus, this research considers earnings management, banking resilience, management efficiency, and return on equity as institutional factors that can affect efficiency levels, thus explaining the adaptive behavior of the shares traded by these companies.

3. Methodological procedures

3.1 Sample selection

The research aims to verify the effects of institutional factors on the efficiency of securities traded in banks listed on the Brazilian capital market and consider banks from the public and private segments as a sample. We present the exclusion criteria for selecting the final sample in [Table 1](#).

In [Table 2](#), we display the banks selected according to the criteria adopted. Due to the Brazilian banking market concentration, the banks participating in the sample represent the majority of the segment's assets.

We observe an equilibrium between private (4) and public banks (5) in the research sample. We stress that the period analyzed comprises the years from 2000 to 2018. However, not all companies used in this study have information every year. Thus, we carried out the analysis employing regression with unbalanced panel data. Information from 9 institutions between 2000 and 2018 was analyzed, totaling 135 observations in an unbalanced panel.

3.2 Dependent variable – Hurst Exponent

We employ as a dependent variable in the Hurst Exponent research, which represents a measure of predictability in the return of securities traded in capital markets ([Tzouras et al., 2015](#)). Among the methodologies used in studies on AMH, [Tripathi et al. \(2020\)](#) point out the use of tests by Hurst Exponent as indicated.

The analysis of this exponent was proposed in the study by [Mandelbrot and Wallis \(1969\)](#), which determines memories in time series. The result of this exponent varies between 0 and 1. Values between 0.0 and 0.5 represent the nonpersiveness of the series, while between 0.5 and 1.0 represents persistence ([Mandelbrot and Wallis, 1969](#)).

We calculated Hurst Exponent following [Tzouras et al. \(2015\)](#):

$$H = \frac{\log(R/S)}{\log(N)} \quad (1)$$

N = Total number of observations; S = Standard deviation of the daily price variation; R = Amplitude of the price variation; and \log = Natural logarithm.

This study transformed the variation from 0.0 to 1.0 into -0.5 to 0.5 , as approached in the [Santos \(2018\)](#) study. We used this weighting because securities with values close to zero (0.0) are more efficient, while securities that are more distant from zero (positively or negatively) are more inefficient. After transforming the variation, we treated the value in the module – thus representing a variation from 0.0 to 0.5. For this purpose, we consider that the higher, the lower the efficiency of the security trade.

3.3 Independent variables

Earnings management in the banking sector is, in general, based on credit allowance accounts. Thus, as the study initially aims to verify whether management practices in the financial sector reflect the efficiency of securities in the market, the first independent variable used in the regression model is the Provision for Doubtful Settlement Credits (PDSC). We also analyzed other variables as possible influences on the efficiency of securities in this segment. The following factors are analyzed: Basel Index (BI), Efficiency Index (EI), Return on Equity (ROE), Size (SZ), and Type of Entity (TE). [Table 3](#) provides information on the independent variables of the research, including the name of the variable, measurement, author, and source of the collection:

According to [Table 3](#), we adopted six independent variables for a dependent variable that comprises market efficiency, as explained in the previous subsection. Therefore, the

Table 1.
Research sample

Companies with shares traded in B3 belonging to the “banks” sector	24
(–) Companies with unavailable data	(7)
(–) Companies with low liquidity/low daily data on their shares	(8)
(=) Final sample	9

dependent variable, presented by the Market Efficiency (ME), was obtained through the Hurst Exponent.

3.4 Quantitative methods applied

For the analysis of the relationship between the independent variables and the research dependent variable, the regression method with panel data will be used, bearing in mind that the data present cross-section cutouts for 19 years.

We performed Chow, Hausman, and Breusch-Pagan tests to provide the best diagnosis to be applied. We also performed heteroscedasticity, normality, autocorrelation, and multicollinearity tests to validate the regression model adopted.

We used the regression model through the following equation:

$$|ME|_{it} = \alpha_0 + \beta_1 PDSC_{it} + \beta_2 BI_{it} + \beta_3 EI_{it} + \beta_4 ROE_{it} + \beta_5 SZ_{it} + \beta_6 TE_{it} + \mu_{it} \quad (2)$$

Where:

$|ME|$ = Module of market efficiency for each company i , in period t ; $PDSC$ = Provision for Doubtful Settlement Credits relativized by the total assets of each company i , in period t ; BI = Basel Index of each company i , in period t ; EI = Efficiency Index of each company i , in period t ; ROE = Return on Equity of each company i , in period t ; SZ = Size of the company represented by the natural logarithm of total assets of each company i , in period t ; TE = Type of entity, public or private, for each company i , in period t ; and μ = Error term of the regression.

Private banks	Public banks
Bradesco	Banco da Amazônia (Basa)
BTG Pactual	Banco de Brasília (BRB)
Itaú	Banco do Brasil (BB)
Santander	Banco do Estado do Espírito Santo (Banestes)
	Banco do Estado do Rio Grande do Sul (Banrisul)

Table 2.
Banks in the research sample

Variable	Definition	Authors	Expected relation
Provision for doubtful settlement credits (PDSC)	Ratio of PDSC balance to total assets balance, for each bank i in period t (PDSC/AT)	Elnahass <i>et al.</i> (2018)	(+)
Basel index (BI)	Ratio of reference equity to risk-weighted assets, for each bank i in period t (PR/RWA)	Pinheiro <i>et al.</i> (2015)	(-)
Efficiency index (EI)	Ratio of administrative expenses to the sum of Financial intermediation Income and service revenues (AE/FII + SR)	Self-elaboration	(+)
Return on equity (ROE)	Ratio of Net Income to equity bank in i in period t (NI/EQ)	Oz and Yelkenci (2018)	(-)
Size (SZ)	Natural logarithm of total assets, of bank i in period t	Ellul and Yerramilli (2013)	(-)
Type of entity (TE)	Dummy receiving 1 for private companies and 0 for public companies	Self-elaboration	(?)

Table 3.
Independent variables and measurement bases

4. Research results

4.1 Descriptive statistics

In order to perform inferential analysis of the variables included in the study, it became essential to run descriptive analyses regarding the measures of position and dispersion of the sample. Therefore, it is evident in Table 4 information regarding the mean, median, minimum, maximum, standard deviation, and coefficient of variation of the dependent and independent variables of the study.

The results referring to the above variables provide pertinent information to the variables. We noted that in general, except for the Efficiency Index (EI), the variables present low variation, with relatively low standard deviation and coefficient of variation. The other characteristics (mean, median, minimum, and maximum) for all the variables show us that the variables are comparable, comprising indexes used in regression models, except for the variable EI. However, this is not an obstacle for its use in inferential models.

4.2 Panel diagnostic tests and regression validation

For selecting the best regression model with panel data, it was necessary to proceed to Chow, Breusch-Pagan, and Hausman's tests to define among the most appropriate panel effects. The Chow test pointed a p -value = 0.2504; that is, for p -value > 0.05, we did not reject the null hypothesis. The Breusch-Pagan test, which determines which random and one-way fixed effects is preferable, pointed for p -value = 0.3999; that is, for p -value > 0.05, we have not rejected the null hypothesis that the one-way fixed effect is preferable. Thus, through the Chow and Breusch-Pagan tests results, the analysis of Hausman's test is dispensed with because the one-way fixed effect model is the most adequate for this data set.

The tests to validate the regression models used were: White test for heteroscedasticity, normality of residues, and Wooldridge test for autocorrelation in panel data, multicollinearity test, and the stationarity test. The heteroscedasticity test provided a p -value = 0.0040, i.e. as the p -value < 0.05, the null hypothesis of absence of heteroscedasticity is rejected, thus making it necessary to use the HAC Matrix to correct the problem residues. The residues normality test showed a p -value < 0.0000; that is, we rejected the null hypothesis of normality in the distribution of the residues. However, given the number of observations ($N = 135$), it is assumed that the data have normality. Finally, the autocorrection test provided a p -value = 0.3616, and the p -value > 0.05 does not reject the null hypothesis of the absence of the first-order autocorrelation.

Through the Inflation Factors of Variance (IVF), the multicollinearity test provided results that all independent variables are between 1.016 and 1.872. Furthermore, none of the values is above the limit ($IVF > 10$), which denotes that the variables have no relation among themselves. Finally, the Dickey-Fuller test for the variables presented p -value < 0.00, which rejects the null hypothesis of unit root, thus indicating that the series is stationary, except for the SZ variable, where we observed that stationarity was the first difference. Because only the

Variable	<i>M</i>	Mdn	Min	Max	SD	CV
ME	0.0463	0.0339	0.0002	0.5000	0.0599	1.2943
PDSC	0.0251	0.0249	0.0038	0.0742	0.0123	0.4937
BI	0.1856	0.1698	0.0854	0.6224	0.0776	0.4183
EI	4.7190	0.3164	-4.1159	584.05	50.241	10.647
ROE	0.0960	0.0898	-0.2470	0.8043	0.0827	0.8616
SZ	7.8671	7.8956	6.3061	9.1740	0.8839	0.1123

Note(s): For the variable TE, 44% of the companies are private and 56% public

Table 4.
Descriptive analysis of
the sample

variable SZ showed non-stationarity, we did not estimate the regression model in the first difference.

Thus, given the results of these tests, the use of one-way fixed was defined as the effect of panel data, and the validation tests showed that it is necessary to correct heteroscedasticity through the HAC Matrix. The results shown below have the appropriate corrections.

4.3 Results of the regression model with panel data

In order to verify which aspects of the banking sector most influence the efficiency of the securities traded in the Brazilian capital market, aspects were used that include proxies related to the management of sector results, banking resilience, resource efficiency, return, size, and whether the bank belongs to the public or private sectors. Thus, the model shown in Table 5 has Market Efficiency (ME) as the dependent variable, and the other attributes are the independent variables.

Through the results provided above, we observed that three of the six independent variables used in the regression model positively or negatively affect the market efficiency observed by the Hurst Exponent.

The variable that denotes the level of management of financial sector results through the PDSC provided a positive and significant relationship at the level of 5% with the low efficiency of the securities of banking companies. Thus, this result proves that result management practices, through the use of loss provisions, are perceived negatively by the market, with negative reflexes to the level of efficiency, i.e. companies with more massive amounts of losses (result management index) tend to present lower efficiency (or higher inefficiency) of the securities traded in the market.

Thus, we noted that the market reacts negatively to this aspect that denotes low-quality information since the provisions account represents a management tool, not being well perceived by the market.

The Efficiency Index (EI) represents the efficiency in the management of the financial institution's resources, which relates the administrative expenses by the results obtained in the intermediation operations and the rendering of services. Therefore, the higher this index, the more inefficient the financial institution is in managing its resources. The result obtained among the EI with the efficiency was positive and significant at 1%. However, even significant, the coefficient of this result was low, close to zero. Therefore, the efficiency of the institutions generates greater financial stability, which economic agents eventually perceive to the level of efficiency of securities traded in the Brazilian capital market.

	Coefficient	Standard error	T-ratio	p-value	Significance
Constant	0.139598	0.0593438	2.352	0.0465	**
PDSC	1.15496	0.497412	2.322	0.0488	**
BI	-0.0774260	0.0451310	-1.716	0.1246	
EI	7.94697e-07	5.13641e-08	15.47	<0.0001	***
ROE	9.81021e-07	0.000423322	0.002317	0.9982	
SZ	-0.0133245	0.00652286	-2.043	0.0754	*
TE	-0.00926381	0.00686484	-1.349	0.2141	

Note(s): $R^2 = 0.127163$; R^2 Adjusted = 0.086248; and p -value (F) = 3.02e-06. PDSC = Provision for Doubtful Settlement Credits; BI = Basel Index; EI = Efficiency Index; ROE = Return on Equity; SZ = Size of the company represented by the natural logarithm of total assets; TE = Type of entity, whether public or private. ***, ** and * correspond to the statistical significance at the levels of 1 5 and 10% respectively. The HAC matrix corrected the model

Table 5. Regression test with panel data (one-way fixed effect) – ME dependent variable

Thus, this result denotes a significant relationship, that the more inefficient a bank resource management is, the more inefficient the securities traded in the market tend to be. However, even if the market perceives this index, its effects are minor, given the regression coefficient.

Finally, on the size of companies, represented by Size (SZ), the ratio obtained was negative and significant at the level of 10% with efficiency, i.e. larger companies have a greater tendency to present efficiency in the market in their securities.

4.4 Additional analysis

In this additional section, we have tried to analyze the most critical variables in the regression through the stepwise regression method. We have based this procedure on an algorithm that includes or excludes independent variables from the model based on decision rules. Therefore, in Table 6 below, the results are given for the most significant variables in the model previously shown in Table 5.

The results provide evidence similar to that evidenced in the previous subsection, i.e. earnings management, resource management efficiency, and the size of banks affect how the levels of efficiency are disclosed to the Brazilian capital market. Therefore, the additional result obtained refers to a marginal significance of 10% obtained in the BI variable.

Therefore, there is additional evidence that the Basel Index (BI) is negatively associated with the inefficiency of the securities. On the other hand, this finding shows that the market reacts positively to the index because companies with more financial stability tend to present greater efficiency in securities traded in the Brazilian capital market. Thus, we understand that this index influences market agents' perception of the financial institution through their securities.

This result corroborates the study by Pinheiro *et al.* (2015), where this index represents financial stability for a bank, thus representing that the market positively receives this information due to the higher efficiency reported by financial companies.

Therefore, given the characteristics adopted in this article, referring to earnings management, banking resilience, management efficiency, and company size, it is noted that efficiency is not constant in this segment. Instead, it is influenced by aspects inherent to variables disclosed by the financial sector. Thus, we noted that efficiency changes according to several factors, which corroborates the Hypothesis of Lo Adaptive Markets (2004, 2005), where institutional aspects influence the efficiency of the markets.

5. Final remarks

Given the particularities and importance of the operations of the financial segment, as well as the relevance in understanding the variations in the levels of efficiency of securities traded in

	Coefficient	Standard error	T-ratio	p-value	Significance
Constant	0.164518	0.0509744	3.227	0.0121	**
PDSC	1.13763	0.510429	2.229	0.0564	*
BI	-0.0839727	0.0394404	-2.129	0.0659	*
EI	7.56121e-07	6.73558e-08	11.23	<0.0001	***
SZ	-0.0167148	0.00596670	-2.801	0.0231	**

Table 6.

Regression test with panel data (one-way fixed effect) – stepwise independent variable

Note(s): $R^2 = 0.123966$; R^2 Adjusted = 0.097011; and p -value (F) = 0.000014. PDSC = Provision for Doubtful Settlement Credits; BI = Basel Index; EI = Efficiency Index; ROE = Return on Equity; SZ = Size of the company represented by the natural logarithm of total assets; TE = Type of entity, whether public or private. ***, ** and * correspond to the statistical significance at the levels of 1, 5 and 10% respectively. The HAC matrix corrected the model

capital markets, this research aimed to verify which specific accounting indicators of the financial sector influence the efficiency of assets traded by financial companies in the stock market in Brazil.

Utilizing a 19-year time frame, through quantitative regression analysis with panel data, we obtained significant results from indicators that explain variations in the reported efficiency of securities traded in the Brazilian market.

The variable representing the management of results through the discretionary provision account for doubtful debts in the financial segment was the first factor that presented statistical significance. Companies that report in the period, indicative of a high degree of management through provisions, tend to have lower levels of efficiency in their shares traded in the Brazilian capital market.

The aspect representing banking resilience or stability, represented by the Basel Index, obtained some statistical significance with market efficiency. In other words, companies that show greater banking resilience tend to have greater efficiency in their securities traded in the market.

Finally, the efficiency in managing resources, through the ratio of administrative expenses to revenues of the segment, represents another aspect significantly associated with the efficiency of the assets traded. The result shows that even though the ratio is significant, the impact of this variable is low since the ratio coefficient was close to zero. However, even if the impact is low, the ratio is significant, which provides evidence that this attribute affects the efficiency of the securities traded.

Among the significant variables used in the model, we highlight the volume of provision for doubtful settlement credits and the entity's size. Banks have used the first to smoothing the accounting result, which may explain its relevance in this result. The second is a proxy for the entity's participation in the market, which is relevant in a typically concentrated market.

These results have theoretical and practical implications. The study contributes to the literature because the findings corroborate the idea that markets are adaptive, having periods of efficiency. However, having this efficiency is affected by aspects related to institutions. Thus, the efficiency appears from time to time cyclically, corroborating with the adaptability of markets proposed by Lo (2004, 2005). The results shown can also contribute to the information users by showing aspects that influence the efficiency of the securities traded in the Brazilian capital market and, to a certain extent, showing attributes that represent quality in the information reported by these financial entities.

The study is limited by the use of only nine companies, given the limitations of financial companies with shares traded, which for the most part, have low liquidity, not contributing to the calculation of a reliable efficiency index. Another limitation refers to the number of variables used. Thus, we suggest future studies analyzing financial institutions from other countries, which would contribute to the increase of the sample and likely insertion of other research variables.

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