PROPERTY STRUCTURE OF STOCK EXCHANGES AND MARKET QUALITY: A STUDY OF THE BOVESPA DEMUTUALISATION

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Abstract

This article investigates the hypothesis that the property structure of organisations is related to the quality of the products and services that they supply. The analysis is accomplished through the study of the Brazilian stock exchange (Bovespa), which modified its property structure through demutualisation and capital opening at the end of 2007. According to the New Institutional Economics (NIE), the modification of property structures could result either in the deterioration of quality, due the need of for-profit firms to increase profits and cut costs, or improvement in quality, due to increases in efficiency. This question is evaluated through Lumsdaine and Papell's (1997) endogenous two structural break test applied on the average bid-ask spread of all stocks traded on the Bovespa. The result indicates that there is a significant break in the series trend during the demutualisation process, suggesting that the property structure change led to an improvement in market quality.

Keywords: New Institutional Economics, Not-For-Profit Organisations, Stock Exchange, Demutualisation, Bid-Ask Spread
JEL codes: E11; G28; G32

1. Introduction

One of the most important occurrences in financial markets in the last twenty years has been the change in the property structures of several stock exchanges. This process began in 1993 with the demutualisation of the Stockholm Stock Exchange and was followed by modifications in other markets around the world. As a special type of firm[1], stock exchanges can be for-profit private corporations, mutual structures of brokers, and closed capital public companies, among other alternatives. In the beginning of 2009, almost all the main stock exchanges of the Organisation for Economic Co-operation and Development (OECD) countries were corporations with explicit profit goals; only three of which had

not listed their own stocks despite being demutualised: the Tokyo, Warsaw and Swiss stock exchanges (OECD, 2009). In 2007, the Brazilian stock exchange (Bovespa), which was the only stock exchange operating in Brazil at the time and is the focus of this paper, changed its structure from a not-for-profit civil association to a for-profit corporation.

Frequent explanations for changes in the property structures of stock exchanges include the need to raise capital and search for more efficient productive processes (e.g. Elliot, 2002; Lee, 2003). These needs have become stronger with the technological revolution that has been occurring since the 1980s and the consequent increased international competition with other stock exchanges. According to the New Institutional Economics (NIE) approach, this change process is beneficial to society in the sense that enterprises make modifications to increase efficiency. Specifically, this school teaches us that, in organisations with profit goals, administrative monitoring is more efficient (Alchian and Demsetz, 1972) and the acquisition of financial capital is facilitated (Hansmann, 1980).

Previous studies have analysed the differences between stock exchanges with distinct property structures. Serifsoy (2007), for example, used data envelopment analysis and the productivity index of Malmquist to evaluate the operational efficiency of 28 exchanges, concluding that property structure explains differences among organisations, although to a small extent. Krishnamurti, Sequeira and Fangjian (2003) analysed the quality measures for two Indian stock exchanges with different property structures and concluded that the demutualised exchange (the National Stock Exchange) provided better quality than its competitor with a mutual structure (the Stock Exchange of Bombay). Given the interest in understanding the differences between for-profit and not-for-profit organisations and the importance of stock exchanges in capital markets, this work aims to conduct an econometric exercise related to the demutualisation of the Brazilian stock exchange. It does not intend to fully evaluate this process but rather to verify if there were statistically significant changes in average spreads, which are considered to be an informational measure of quality, at the Bovespa during the time this change took place.

The analysis will be conducted using daily bid-ask spread series and applying Lumsdaine and Papell's (1997) model of two endogenous structural breaks to test the unity root null hypothesis against the alternative hypothesis of stationarity with trend. The choice of a two-break rather than a one-break model is the result of a visual examination of the data. Endogenous structural break models allow for the evaluation of whether the timing of the change in the property structure of Bovespa is associated with any significant alterations in the bid-ask spread series, with the advantage of not having to specify the period of change *a priori*. The results indicate that there was a significant break in the series trend when the demutualisation occurred. The reversal of the bid-ask spread trend during the demutualisation suggests that the change in the property structure of the Brazilian stock exchange is associated with an improvement in the quality of the information it provides.

This paper is structured into five sections, including this introduction. In the second section, the theoretical aspects related to changes in property structures will be presented. The third section is dedicated to describing the methodology and presenting the data. The fourth section shows the results and the fifth and final section includes final considerations.

2. Literature Review

A potential theoretical foundation to analyse changes in the property structures of stock exchanges is the neoclassic Industrial Organisation perspective. However, it would not be appropriate to employ this theoretical construct to explain the change in the property structure of the Bovespa because it assumes a monopolistic motivation for contractual alterations and reformulations (Williamson, 1985 and 2008) and the Brazilian stock exchange held a *de facto* monopoly on stock transactions in the country before demutualisation occurred in 2007.

An alternative theoretical foundation is the New Institutional Economics (NIE) which advocates that modifications in contractual structures occur as endogenous processes within organisations in their search for efficiency in production and resource allocation. The New Institutional Economics approach fits the Kuhnian conception of paradigms (Kuhn, 1962) because it is composed of a family of theories built on the pillar of limited and bounded rationality that is coherent with the observed real world.

The NIE confronts the rational agent with perfect foresight of the neoclassical school, promoting a revolution in the economic thought of organisations. The year of 1937, when Ronald Coase's classic "The Nature of the Firm" was published, is considered to be a turning point in this revolution. Until then, the economic literature failed to satisfactorily explain why firms exist. Concerned with markets, the mainstream theory at that time restricted itself to viewing organisations as "black boxes", observing and studying them through a given production function. The NIE takes a step further, adopting transactions instead of markets as the focus of analysis. This approach does not see the firm as a hermetic unit, thereby making it possible to examine several of its previously neglected aspects.

According to Williamson (2000), the NIE's analyses address formal institutions and governance structures. With this delimitation, the author considered the informal restrictions related to habits and social traditions to be well-known by analysts. In other words, changes happen in the long term and are therefore assumed to be fixed. In a simplified manner, the different theories that compose the NIE can be grouped in two major categories: incentives and transaction costs (Williamson, 1985). They share some commonalities in addition to the previously mentioned fact that the objects of analysis are transactions rather than markets. Among the main commonalities, the recognition of the importance of property rights, understood as the right to use, appropriate or change the form or substance of assets, is particularly noteworthy. (Williamson, 1985, p.24) According to Buchanan (1975, p.225), analysing the implicit mutual

benefits in voluntary transactions according to the contract perspective rather than the neoclassical approach allows for a better comprehension of exchanges.

Demsetz takes a broad view of property rights, stating that they are "an instrument of society and derive their significance from the fact that they help a man form (…) expectations which he can reasonably hold in his dealings with others" (1967, p.347), with such expectations being formed by laws and habits. With this characteristic, the property right serves the allocative function of internalising existing externalities, thereby reducing the bargaining costs involved in a conflict or business. In other words, the property rights specification determines how costs and rewards will be allocated. In addition, because property rights are specified via contracts, the behaviour of organisational managers will depend on the nature of these contracts.

Through the property rights theory, it is possible to explain business quality in stock exchanges. Two of the main products of a stock exchange involve publishing information on companies, a task they share with regulators like the Comissao de Valores Mobiliarios (CVM) in Brazil, as well as information on the transactions conducted in its business environment. In this sense, for price information to be comparable over time, a certain standardisation of contracts and negotiated stocks is desirable. This occurs when appropriate property rights specifications underlie the conducted negotiations, such as the sales date and the rights that the new stock owners will have. In this sense, good stock exchange quality will only be obtained if the property rights of the traded stocks are well specified.

In this property rights context, limited liability over shares allowed for the development of capital markets, creating incentives for the participation of wealthy shareholders. According to Demsetz (1967):

> (…) "limited liability considerably reduces the cost of exchanging shares by making it unnecessary for a purchaser of shares to examine in great detail the liabilities of the corporation and the assets of other shareholders; these liabilities can adversely affect a purchaser only up to the extent of the price per share." (p.359)

The agency theory has developed independently from the property rights theory, despite the fact that the research goals of both are quite similar. In a classical paper related to agency theory, Berle and Means (1932) proposed the existence of a conflict between the goals of managers and stockholders, indicating the superiority of companies managed by owners relative to corporations with diffused ownership due to the emission of stocks. In addition to accepting the possibility of this conflict, at least partially, Berle and Mean's conclusions have been questioned over time. According to Jensen and Meckling (1976), for example, the growth of open capital corporations suggests that the benefits of the diffusion of control outweigh its costs. For Demsetz (1983), the distance between the interests of managers and stockholders is reduced by the existence of a high percentage of managers who are also stockholders and whose remuneration is largely based on stock performance as well as the implicit monitoring imposed by variations in stock prices.

The conflict in the relationship between managers and owners, known as the principal-agent relationship has generated a broad range of works seeking to create mechanisms to align incentives *before* the composition of contracts in order to increase the efficiency of exchanges. In the real world, the costs of redrawing property rights are not negligible and different contractual relations defined *ex ante* cannot be efficient *ex post*. The second group of NIE theories, known as the Transaction Costs Theory, was generated in this environment. This theory proposes that the decisions made by agents after contract formulation can be changed by their opportunistic behaviour, and this, together with the non-negligible costs related to the legal system, allows for a larger focus on *ex post* contracts within private institutions (or support institutions).

The Transaction Costs Theory was developed based on the perception that the neoclassical theory's neglect of transaction costs, sometimes referred to as null transaction costs, is not plausible in the real world. According to Coase (1937), the explanation for the existence of firms would be that they save transaction costs. Otherwise, the exchanges that take place within firms would occur via markets. This make-or-buy decision is sensitive to the attributes associated with transactions. Specificity in potential investments, whether geographic, physical, or human, increases the current losses related to hold-up, which represent an opportunistic behaviour attributed to agents. Therefore, when investments are highly specific, integration should be the predominant governance structure for transaction costs to be reduced. Saha (2005), for example, justifies the appearance of stock exchanges as organisations through the reduction of the costs incurred by brokers in negotiating with each other in the usual way, through an unorganised market without sale and compensation warranties for their businesses.

The warranties cited above can be made intrinsically possible through the property rights specifications of the negotiated stocks, as previously mentioned, but they will only produce the desired result if such rights are guaranteed and implemented by some formal organisation that is supported by laws and habits. In this context, restrictions to over-the-counter businesses, which enjoy information about prices formed in stock exchanges but do not contribute to the costs associated with covering the publication of quotes, can be regarded as an opportunistic behaviour that should increase the costs of global stock transactions. This conclusion supports changing stock exchanges to closed organisations and suggests that the monopolisation of transactions improves well-being.

Alternative governance structures are also debated in the NIE context. Not-for-profit and structured organisations such as cooperatives deserve the special attention they have received from several authors. Some of these ideas are presented below.

2.A.   *Not-for-profit[2] and Cooperative Organisations*

Hansmann (1980) sought to comprehend the role of not-for-profit organisations, defined by the non-distribution restriction in which it is impossible for profit to

be appropriated by owners or sponsors.[3] The author has created a taxonomy of such organisations, embracing their financial and control structures. Financial structures could be commercial, if they generate resources from their own activities, or based on donations. In terms of control structures, organisations can be managerial, if administrative freedom is provided by their patrons, or mutual, if backers exercise control. In this taxonomy, Bovespa could be viewed as a commercial, mutual and not-for-profit organisation until 2007.

In 2001, Bovespa merged with 11 other Brazilian exchanges, forming a *de facto* monopoly. As the monopolist of stock trading in the country and still characterised by a mutual not-for-profit structure, Bovespa could increase its prices or trading fees but member-brokers could still not easily appropriate excess profits. Noia (2000) explains the old stock exchange cooperative structure as a strategy to prevent monopolistic rent appropriation given the market power of local stock exchanges. Becoming a for-profit organisation is thus justified as a means of allowing members to appropriate excess profits. Another explanation could be that not-for-profit firms may suffer from multiple goals and conflicts. Whereas some members may desire to minimise fees, others may pursue the maximisation of trading volume or other goals. Kanter and Summers (1987) note that not-for-profit firms are characterised by the temporary alliances of separate groups, each of which interprets the organisation's goals slightly differently. Different objectives could make the raising of capital to invest in new technologies cumbersome, with some members desiring to invest more than others. Furthermore, the horizon-goal problem referred by Lee (1998) also makes investment difficult. Therefore, obstacles to obtaining financial capital, without the possibility of offering stocks to the public, could help justify the appearance of the for-profit structure.

It is frequently argued that when consumers are unable to correctly evaluate the promised and the delivered products, regardless of whether this is caused by the transaction circumstances or the characteristics of the product, there will be more well-being if the products are supplied by not-for-profit organisations. This is because not-for-profit organisations have more restrictions on increasing prices or decreasing quality due to the distribution of profits being impossible by definition. In other words, the advantage of these organisations is that "the discipline of the market is supplemented by the additional protection given the consumer by another, broader 'contract', the organisation's legal commitment to devote its entire earnings to the production of services" (Hansmann, 1980, p.844). However, Alchian and Demsetz (1972) compared not-for-profit organisations to open capital corporations with profit goals, and noted that more opportunistic behaviour, which reduces average productivity, could be expected from the not-for-profit organisations. This is because they are not subject to monitoring through the possibility of the easy and fast transfer of property rights, a feature observed in open corporations. In other words, there is a lack of efficiency in the administration of not-for-profit

organisations due to the incorrect alignment of incentives that the absence of profit distribution provokes.

Hart and Moore (1996) analysed pricing practices among cooperatives with conflicting goals, i.e., organisations with and without profit goals. According to the authors' model, which examines decisions by average voters, in the case members' distribution hangs for the firms with larger production cost, the organisation will prefer to act with profit goals. Moreover, in line with the result of Hansmann (1988), it can be argued that some deficiencies generated by the decision-making process of cooperatives will be minimised if their members are homogeneous. In contrast, according to Pirrong (1999), cooperatives with profit goals should be dominant over not-for-profit ones. His argument is based on the possibility of exercising market power that could be detrimental to a cartel compelled by a not-for-profit cooperative.

According to the brief review above, the NIE explains several characteristics of stock exchanges, such as their appearance and development. Moreover, this perspective facilitates the comprehension of changes in the property structures of these organisations. Such changes could affect the products supplied by the stock exchanges i.e. information. Whether the change in the Brazilian stock exchange led to deterioration in quality or transaction costs for traders, due to the need to raise profits and cut costs, or due to an improvement in quality, or due to an increase in efficiency, is a question that needs to be answered empirically.

3. Methodology and Data

The main goal of this paper is to verify if there was a break in the time series measure related to the business quality of Bovespa around the period when its property structure was changed. The employed measure was the daily average bid-ask spread from all the stocks negotiated on the Bovespa, $SPDAY_{i,t}$, which was calculated by the bid-ask spread of each stock leveraged by its daily trading volume.

First, we calculated $SP_{i,t}$, which was the difference between the last best bid ($BID_{i,t}$) and the last best ask ($ASK_{i,t}$) divided by the average of these two prices for each stock i on each day t. Algebraically, $SP_{i,t} = (ASK_{i,t} - BID_{i,t})/[(ASK_{i,t} + BID_{i,t})/2]$. The daily average bid-ask spread ($SPDAY_t$) was then calculated for each day t by multiplying $SP_{i,t}$ with the ratio of its volume ($VOL_{i,t}$) and the total volume negotiated at the same t ($\Sigma VOL_{i,t}$). Algebraically, $SPDAY_t = \sum_{i=1}^{n} SP_{i,t} \left(VOL_{i,t} / \sum_{i=1}^{n} VOL_{i,t} \right)$.

Many papers in the finance literature investigate whether there is a correlation between the costs of trading stocks and other variables, such as stock prices and transaction volumes. It is common for these papers to employ the bid-ask spread as a proxy for the true transaction costs of trading stocks. A

large spread indicates higher costs; that is, a buyer must pay a higher mark-up on the price and the seller must accept a higher discount than he/she would receive with narrow spread. Furthermore, the works of Atkins and Dyl (1997) and Bessembinder (2003) lead to the conclusion that there is a strong negative correlation between volume and spread, meaning that traders will gravitate toward market places with low costs. Thus, spreads from other market places and volumes could be regarded as determinants of local spreads. Some other variables, such as market volatility and broker concentration, potentially affect the generated spread series. Volatility is directly related to spread and an increase in broker concentration could cause an increase in spreads because the direct costs of stock transactions would rise due to the brokers' ability to exercise market power.

Evaluations of changes in property structures should expurgate the influence of the determinants of the bid-ask spread cited above. Thus, this structural break evaluation calculated the error term (u_t) of the estimation using the ordinary least squares method in the equation 1 below. All the variables were transformed into monthly averages before estimation. This was due to the availability of concentration data, and was also necessary to calculate standard deviations of returns.

$$(1)\quad SPMED_t = \beta_0 + \beta_1 SPADR_t + \beta_2 C8_t + \beta_3 VOL_t + \beta_4 DPBRA_t + u_t$$

The variable $SPMED_t$ is the monthly average of the daily bid-ask spreads ($SPDAY_t$); $SPADR_t$ is a control variable that proxies for the NYSE spread. The employed variable is the average bid-ask spread in month t excluding stocks with American Depositary Receipts. This variable aimed to capture the costs of international markets; $C8_t$ is a control variable calculated as the concentration ratio of the 8 brokers with the largest volume in the Bovespa in month t; VOL_t is a control variable calculated as the average stock broker volume in month t; and $DPBRA_t$ is a control variable calculated as the standard deviation of monthly average Bovespa returns. This variable aimed to capture the risk perception of Bovespa's stocks.

All the variables were employed as logarithms and they covered the period from July 1999 to August 2009. Table 1 presents a statistical summary of the variables.

Table 1: Descriptive Statistics of Variables

Variable	Obs	Mean	Std.Dev.	Min	Max
$SPMED_t$	125	(5.00)	0.39	(5.87)	(4.12)
$DPBRA_t$	125	(3.60)	0.27	(4.03)	(2.56)
$SPADR_t$	125	(6.16)	0.41	(7.02)	(5.29)
$C8_t$	125	3.74	0.14	3.38	3.95
VOL_t	125	16.27	0.63	15.14	17.78

Source. www.bovespa.com.br.

After obtaining the error term from we applied an endogenous structural break test. These types of tests evaluate the unitary root hypothesis against the alternative stationarity with trend hypothesis. They can be employed, for instance, to evaluate the existence of a change in the series due to public policies. Furthermore, if politics are treated endogenously, the test extracts the period of the level or trend rupture as a by-product. Lumsdaine and Papell's (1997) model was employed because two apparent breaks were detected through a visual inspection (see Graph 1). Further information regarding the structural break models can be found in the Appendix.

4. Results

We first conducted the estimation of equation 1 to obtain the error series and proceeded to identify any structural breaks on them. The estimation was satisfactory, with a high R-squared (72.8%) and the individual statistics of almost all the variables showing significant results with the expected signs. Exceptions occurred with the $DPBRA_t$ parameter, which is a risk measure that showed no impact on spread average, and VOL_t, which showed a sign that was different from what was expected. However, the parameter of the $SPADR_t$ variable suggests that the spreads of Brazilian stocks are influenced by spreads in global markets and the $C8_t$ variable suggests that an increase in the market power of brokers reduces the average spread. The main estimation results can be seen in Table 2.

Table 2: Estimation Results from Equation 1 (Endogenous: SPMED)

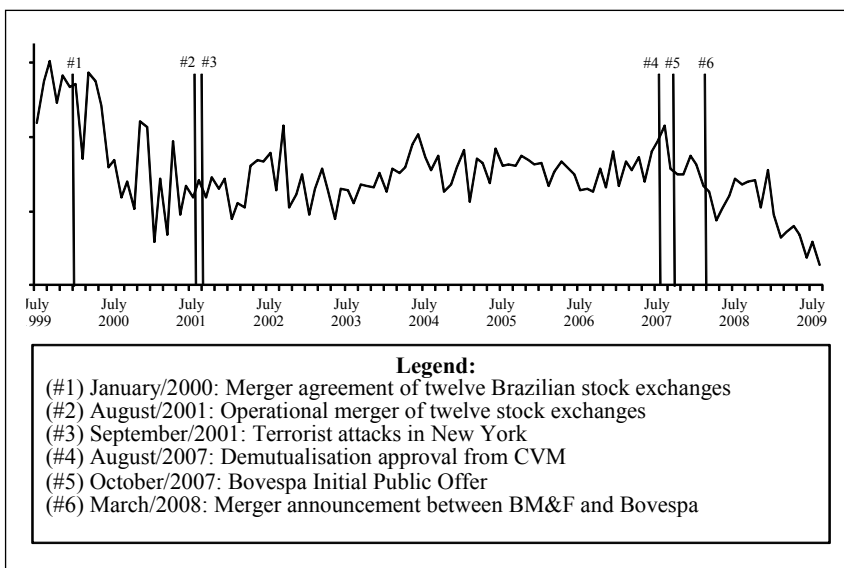| Variable	Coefficient	t statistic	p-value
$DPBRA_t$	0.0408	0.57	0.571
$SPADR_t$	0.6568	9.32	0.000
$C8_t$	-2.116	-12.61	0.000
VOL_t	0.2241	4.11	0.000
Constant	3.4711	5.83	0.000
125 observations - R^2: 0.728 - F Statistic: 84.08			

Source. Authors.

Graph 1 presents the evolution of errors; the vertical bars indicate the following important events that could have influenced changes in the bid-ask spread structure.

A visual examination of the Graph 1 suggests that the error series exhibit trends with breaks shortly before the stock exchange mergers and around Bovespa's demutualisation. To evaluate the series behaviour and the possible break dates, we applied the CC model of Lumsdaine and Papell (1997), whose estimation results, without the augmented term, are shown below:

$$y_t = 0.41 - 0.022t + 0.080\,DU1_t + 0.023\,DT1_t + 0.095\,DU2_t - 0.015\,DT2_t - 0.614\,y_{t-1}$$

$\qquad$ (5,259) $\quad$ (−4,69) $\quad$ (1,321) $\qquad$ (4,745) $\qquad$ (1,549) $\qquad$ (−3,82) $\qquad$ (−6,08)

$\qquad$ [0,000] $\quad$ [0,000] $\quad$ [0,189] $\qquad$ [0,000] $\qquad$ [0,124] $\qquad$ [0,000] $\qquad$ [0,05] ,

Legend:
(#1) January/2000: Merger agreement of twelve Brazilian stock exchanges
(#2) August/2001: Operational merger of twelve stock exchanges
(#3) September/2001: Terrorist attacks in New York
(#4) August/2007: Demutualisation approval from CVM
(#5) October/2007: Bovespa Initial Public Offer
(#6) March/2008: Merger announcement between BM&F and Bovespa

Source. Author.

Graph 1: Error Term (μ_t) from Equation 1 with Event Dates

$\qquad$ The values in parentheses are the *t*-statistics and the values in brackets are the p-values. Statistically, the results indicated that there were breaks in the tendency (*DT1* and *DT2* with *t*-statistics of 4.74 and -3.82), though not in the intercept (*DU1* and *DU2* with *t*-statistics of 1.32 and 1.54) of the series. According to the conducted estimation, the null unitary root hypothesis was not rejected at a 5% confidence level in favour of a stationary series with breaks.

$\qquad$ Graph 2 presents the error terms from equation 1; the grey lines indicate the series tendencies and the thick vertical lines indicate the periods of structural breaks, which the results suggest occurred in March 2001 and May 2007. The first date was shortly before the announcement and the effective merger of the Brazilian stock exchange. The second date was shortly after the demutualisation announcement and the capital offering by Bovespa. The results were therefore aligned with the idea that the stock exchange merger and Bovespa's demutualisation affected its quality, i.e. the bid-ask spread tendency. Furthermore, whereas the merger was associated with a decrease in quality (increase in transaction costs or spreads), demutualisation was associated with an improvement in quality (decrease in transaction costs or spreads).
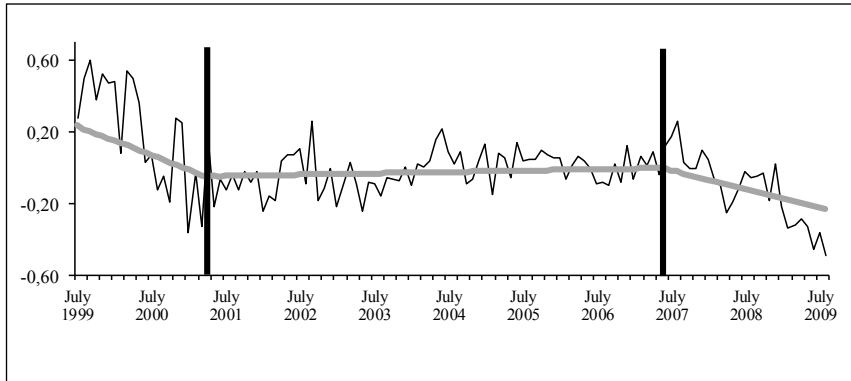
Source. Author**.**

Graph 2: Error Term (μ_t) with Trends and Break Dates

5. Final Considerations

Changes in property ownership structures are important events to be investigated, especially those related with the demutualisation of stock exchanges, a process that began in 1993 with the change in the ownership structure of the Stockholm Stock Exchange. This subject is relevant because of the magnitude of trading in stock markets and also because it begins a theoretical discussion about the inappropriateness of neoclassical economics in explaining these types of phenomena. In this sense, this paper explored Bovespa's demutualisation process, which occurred in 2007. The paper's main goal was to answer the question of whether this change in the property ownership structure was associated with any change in the quality of services provided by the Exchange.

The two different schools provide different theoretical explanations for the demutualisation phenomenon. The neoclassic school heavily emphasises the monopolistic motivation. According to this school, a firm would change its property structure to achieve its monopolistic goals. In contrast, the New Institutional Economics stresses the endogenous motivations of firms in their search for efficiency or the reduction of transaction costs. Because Bovespa retained a *de facto* monopoly when it demutualised in 2007, the neoclassic school could not be employed to explain the ownership change.

The NIE helps to understand some of the aspects of stock exchanges. Through the property rights context, it is possible to understand how contracts correctly specified, regarding to owner rights, can increase the quality of a marketplace such as a stock exchange. Also, the reduction of transaction costs between brokers explains the appearance of stock exchanges as organised markets. The NIE provides several indications of the variations of quality with different ownership structures. A transition from a mutual structure to a for-profit corporation could lead to a decrease in quality, due to the possibility of monopolistic rent appropriation, or

to an improvement in quality, due to the more efficient allocation of resources. In short, there might not be a single answer to the question of the quality implications of demutualisation and it should therefore be addressed on a case-by-case basis. This empirical investigation calculated the daily average bid-ask spreads of all stocks traded on the Bovespa and used it as a measure of quality or transaction costs. Several papers endorsed this choice of variable as a measure of quality (Atkins and Dyl, 1997).

The empirical analysis employed the time series tools, thereby evaluating the existence of structural breaks in the bid-ask spread series. The utilised model was Lumsdaine and Papell's (1997) two-structural-break model, after visual evaluation indicated the presence of two breaks in the series. The results suggest that there were breaks in the spread tendency in March 2001 and May 2007, which were close to the dates when the merger announcement and Bovespa's demutualisation took place. Moreover, the stationary unitary root hypothesis was rejected in favour of breaks and tendency, suggesting that random shocks in the series have temporary effects, with a tendency of the series to return to their long-term paths. The analysis also indicated that Bovespa's demutualisation was associated with a decrease in transaction costs (or an increase in average quality).

The results show that demutualisation did not produce higher costs for traders, as a naive regulator could claim because of the possibility that monopoly power could be exercised by Bovespa. In fact, the spreads revealed the opposite change, with smaller transaction costs for traders after the demutualisation.

Finally, it is important to mention one aspect regarding the coincidence of the second break period with the global financial crisis. Although our research did not intend to find a causal relationship between bid-ask spread changes and demutualisation, we believe that financial crisis endorses our findings that demutualisation is associated with an increase in market quality or a reduction in bid-ask spread. This comes from the perspective that financial crisis implies larger spreads, instead of smaller ones. Trades in a financial crisis are riskier than in a regular period, meaning that the decrease in bid-ask spread we found could be steeper without the financial crisis that took place in 2008.

End note

[1] From the perspective that firms represent long-term contractual relations, whereas markets are sets of spot transactions, stock exchanges should be classified as markets. Mulherim, Netter and Overdahl (1991) examined a set of external and internal contracts from the New York Stock Exchange (NYSE) and the Chicago Board of Trade (CBOT), framing them as particular cases of firms that produce accurate information under quotes. This point of view is adopted in this paper for the case of Bovespa.

[2] We prefer the use of the term not-for-profit over the term non-profit when referring to firms without profit goals. Use of the latter term could be misleading because not-for-profit firm could have profits without aiming for them.

[3] Hansmann (1980) retains the possibility of not-for-profit organisations having profits. The existence of not-for-profit organisations would require that stocks and shares not exist, along with any other property right that permits the holder to control both management and profit distribution.

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Appendix - Structural Break Models

Structural break models became popular after Perron's (1989) study, which called attention to the fact that the existence of structural breaks in time series data could influence the results of traditional unit root tests, such as the Dickey-Fuller and the Phillips-Perron tests. By ignoring permanent breaks in the deterministic components of the series, researchers who use conventional tests would tend to accept the unit root null hypothesis more frequently than if the series were analysed separately before and after the break.

Perron (1989) confronted Nelson and Plosser's (1982) results for thirteen macroeconomic series with those obtained using the new methodology. Perron (1989) rejected the unit root null hypothesis for ten of them. Until this point, there was a reasonable consensus that macroeconomic series were typically stochastic instead of stationary with trend. In this way, shocks would have permanent effects on the series. Perron's (1989) results were based on the following generalisation of the Augmented Dickey-Fuller model with level and trend changes:

(I) $$\Delta y_t = \rho . y_{t-1} + \sum_{j=1} \gamma . y_{t-j} + \mu_t + \varepsilon_t ,$$

where is a deterministic term. The break occurs in time TB. Based on this model, Perron (1989) considered three break possibilities:

- Model I – with trend and break on level:

$$\mu_t = \mu + \beta . t + \theta . DT_t ,$$

- Model II – with breaks on trend and level:

$$\mu_t = \mu + \beta . t + \gamma . (t - TB) . DT_t ,$$

- Model III – combined:

$$\mu_t = \mu + \beta . t + \theta . DT_t + \gamma . (t - TB) . DT_t ,$$

where, for the three models,

$$DT_t = \begin{cases} 1, \text{ if } t > TB \\ 0, \text{ if } t \leq TB. \end{cases}$$

The null hypothesis for each of these models is a unit root, with possible breaks captured by the introduced dummies. The alternative hypothesis reflects a stationary process with breaks. The shock period is identified *ex-ante*

through economic intuition, which allows Perron's work to be characterised as an exogenous structural break model. During the early 1990s, a new class of endogenous model emerged; noteworthy models included those of Zivot and Andrews (1992) and Lumsdaine and Papell (1997).

Zivot and Andrews's (1992) endogenous structural model is characterised by a sequence of tests in which dummies for different periods are applied. The break period is selected according to the smallest *t*-statistic. In other words, a break date is chosen when it is less favourable to the null hypothesis. As a result, this type of test has a greater difficulty in rejecting the unit root hypothesis. The null hypothesis (H_0) of the test proposed by Zivot and Andrews (1992) can be expressed as:

$$H_0: \quad y_t = \mu + y_{t-1} + \varepsilon_t$$

The alternative hypothesis (H_1), as in Perron (1989), is composed in three different manners (A, B and C):

(A) H_{1A}: $y_t = \mu + \beta.t + \theta.DU_\lambda + \alpha.y_{t-1} + \sum_{i=1} c_i.\Delta y_{t-i} + \varepsilon_t$

(B) H_{1B}: $y_t = \mu + \beta.t + \gamma.DT_\lambda + \alpha.y_{t-1} + \sum_{i-1}^{k} c_i.\Delta y_{t-i} + \varepsilon_t$

(C) H_{1C}: $y_t = \mu + \beta.t + \theta.DU_\lambda + \gamma.DT_\lambda + \alpha.y_{t-1} + \sum_{i=1} c_i.\Delta y_{t-}$

where

$$DU_t = \begin{cases} 1, & if \ t > TB \\ 0, & if \ t \le TB \end{cases} \quad and \quad DT_t = \begin{cases} t - TB, & if \ t > TB \\ 0, & if \ t \le TB. \end{cases}$$

The break point TB was chosen to minimise the *t*-statistics of the ADF test, with the most negative values leading to the rejection of the null hypothesis. The selection of one model (A, B or C) was not consensual. A conservative approach was to work with model C, which was the most general.

Lumsdaine and Papell (1997) amplified Zivot and Andrews's (1992) work, allowing for the possibility of a second endogenous break in the series under the alternative stationarity with trend hypothesis and breaks in the level and in the trend. The authors re-examined Nelson and Plosser's (1982) series, testing them for two unknown breaks and rejecting the null unitary root hypothesis for five of the thirteen macroeconomic series.

Lumsdaine and Papell's (1997) test uses logic that is similar to that employed by Zivot and Andrews (1992). The AA model allows for two breaks in the intercept and the CC model allows for two breaks in the intercept and slope. Finally, the CA model has a break in the intercept and trend and a break in the intercept only. These three models can be written as:

(AA) $\quad y_t = \mu + \beta.t + \theta_1.DU1_t + \gamma_1.DT1_t + \alpha.y_{t-1} + \sum_{j=1}^{k} c_i.\Delta y_{t-i} + \varepsilon_t$

(CC) $\quad y_t = \mu + \beta.t + \theta_1.DU1_t + \gamma_1.DT1_t + \theta_1.DU2_t + \gamma_2.DT2_t + \alpha.y_{t-1} + \sum^{k} c_i.\Delta y_{t-i} + \varepsilon_t$

(CA) $\quad y_t = \mu + \beta.t + \theta_1.DU1_t + \gamma_1.DT1_t + \theta_1.DU2_t + \alpha.y_{t-1} + \sum_{j=1}^{k} c_i.\Delta y_{t-i} + \varepsilon_t \, ,$

,

where the dummies *DU1* and *DU2* capture changes in the intercept and the trend dummies are *DT1* and *DT2*, where

$$DU1_t = \begin{cases} 1, & \text{if } t > TB1 \\ 0, & \text{if } t \leq TB1 \end{cases} \quad \text{and} \quad DU2_t = \begin{cases} 1, & \text{if } t > TB2 \\ 0, & \text{if } t \leq TB2 \end{cases}$$

$$DT1_t = \begin{cases} t - TB1, & \text{if } t > TB1 \\ 0, & \text{if } t \leq TB1 \end{cases} \quad \text{and} \quad DT2_t = \begin{cases} t - TB2, & \text{if } t > TB2 \\ 0, & \text{if } t \leq TB2 \end{cases}.$$

As in Zivot and Andrews's (1992) model, the two break tests in TB1 and TB2 were conducted in the period from k+2/T to (T-1)/T, implying *TB2 > TB1 +* 1. The estimation refers to model CC, the most general of the three.