Determinants of Transactions Costs in the Brazilian Stock Market
(Determinantes dos Custos de Transação no Mercado de Ações no Brasil)

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Abstract
The Lesmond (2005) method for estimating transactions costs, based on a limited-dependent variable model, is used in order to test for the significance of plausible explanations for cross sectional cost differences. Variables such as liquidity, volatility, firm size, quality of corporate governance and participation in ADR programs are considered, in addition to the possible impact of the 2008 crisis. Daily data for 1999-2009 are used, covering at least 250 securities each year. The average total transaction cost declined from 2.95% in 1999 to 1.22% in 2009. Stock volatility and quality of corporate governance appear to be the most relevant factors associated with the measure of transactions cost.

Keywords: transactions cost; information asymmetry; stock trading; operational efficiency; limited dependent variables.

JEL codes: C24; C33; D82; G19.

Resumo
Este artigo aplica a estimativa de custos de transação de Lesmond (2005) no mercado brasileiro de ações, apoiada num modelo de variável dependente limitada. O objetivo é testar hipóteses sobre fatores determinantes dos custos de transação no mercado secundário (liquidez, volatilidade, tamanho, governança corporativa diferenciada, participação em programa de ADRs), bem como o impacto da crise de 2008. Utilizam-se dados diários do período de 1999 a 2009, em média com mais de 250 ações por ano. É observado que o custo total médio de transação sofreu redução substancial e continuada em cada ano do período, indo de 2,95% em 1999 a 1,22% em 2009. É verificado que a volatilidade da ação e a participação em níveis de governança corporativa diferenciada são as variáveis explicativas mais importantes.

Palavras-chave: custo de transação; assimetria de informação; negociação de ações; eficiência operacional; variáveis dependentes limitadas.
1. Introduction

In contrast with the assumption of perfect capital markets, the trading of financial assets in secondary markets takes place at a variety of costs, generically called “transactions costs”. In turn, the level and the behavior of transactions costs may be seen as indicators of a market’s overall degree of efficiency, both in operational and informational terms.

Concerning operating efficiency, one acknowledges the presence of costs we might call explicit; for example, these include the expenses directly charged by brokers (brokerage fees) and the stock exchange itself (exchange fees), any rigidities caused by the processing of order flow, including trading hours, and even taxes, especially those on trading volumes, such as the Tax on Financial Transactions (IOF) and the Contribution on Financial Transactions (CPMF).

In terms of informational efficiency, the most important obstacle to the free trading of financial assets is the possible asymmetry of information between the buyer and the seller of particular asset. Since the transactions costs resulting from information asymmetries are not directly observable, we might characterize them as implicit costs. These result in the over-pricing or the under-pricing of securities. In the former case, a seller demands a premium for trading with a buyer with potentially superior and favorable information. In the latter, the buyer requires a discount for trading with a seller with potentially superior and negative information.

It is reasonable to expect, therefore, that the greater the efficiency with which information is impounded in market prices, the lower would these costs be. Hence, their magnitude may be an important indicator of a market’s informational efficiency. Another potential effect of trading itself on prices, leading them away from true values, is Hasbrouck’s (1991) “market impact” effect, also attributed by that author as a permanent effect due to the information contained in security trades.

This article’s objective, of an essentially empirical nature, is to provide an assessment of total transactions costs in the Brazilian stock market, starting from the adverse selection argument proposed and developed in Glosten & Milgrom (1985), and using the methodology developed and applied by Lesmond et al. (1999) (heretofore referred to as LOT) to estimate the resulting transactions costs.

More specifically, this article presents results from measuring total transactions costs, for individual stocks traded in Brazil in the 1999-2009 period, and the analysis of how such costs are related to individual security and firm characteristics, such as stock liquidity and volatility, the issuer’s level of corporate governance, and the measures of the issuing firm’s quality, such as size and participation in American Depository Receipts (ADR) programs.
This article contributes to the existing literature on the Brazilian stock market by demonstrating the feasibility of estimating transactions costs directly, with the use of observed prices in the so-called LOT approach. The competing alternative is to use the PIN (probability of informed trading) approach, which, as its name indicates provides estimates of those probabilities, and not rates representing transactions costs.

In addition, the LOT approach can be implemented with much smaller data demands. As this paper indicates, one can use daily data, which are readily available, instead of having to rely on trade-by-trade data, which are not widely accessible to analysts.

With the technique herein employed, market professionals are able to compare the costs of information asymmetry associated with various firms, thus helping to guide their efforts at collecting additional information on firms for which estimated transactions costs are higher.

In addition to this Introduction, the article is organized as follows. Section 2 presents a review of the literature, with an initial emphasis of the problem’s conceptual dimensions; there follows a description of the main empirical results available in the literature, along with the various estimation methodologies proposed. Section 3 describes the method for the estimation of transactions costs based on a logit model. At that point, that methodology is compared with the so-called “probability of informed negotiation (PIN)” approach. Next, section 4 describes the data used, and section 5 presents the results. Section 6 concludes.

2. Review of literature

According to Lesmond (2005), the main methods for the estimation of transactions costs in stock markets include those that follow.

The first two types of methods are based on trading volume data, including turnover and the Amihud (2002) measure.

Turnover corresponds to trading intensity, but does not lead to the estimation of a magnitude for a transaction’s, which may vary from one stock to another, presumably as a function of different stocks’ characteristics. By definition, a stock’s turnover is the ratio of physical volume traded and the amount of shares outstanding for each class and firm. A higher turnover would correspond to higher liquidity and, thus, to a lower cost for that liquidity. However, it is an inadequate measure of transactions costs that may include uncertainty as to the security’s intrinsic value, in addition to adverse selection measure. At times of crisis, volume and turnover tend to increase exactly when such problems presumably intensify.

In turn, the Amihud (2002) measure uses the ratio between a stock’s daily return’s absolute value and its daily financial volume of trading. This measure corresponds to the notion of price impact, in the sense that it assesses the reaction of prices to the flow of buy and sell orders. Presumably, the higher the value of that measure, the higher the stock’s transactions costs; however, this measure does not result in a cost estimate.
The Roll (1984) measure attempts to infer transactions costs indirectly from price behavior, and not from the volume of trading. It involves the estimation of effective spreads implicit in bid and ask quotes from the negative auto-correlation produced by the bouncing between those quotes. Hence, the higher that auto-correlation, the larger the spread, that is, the implicit transactions cost. Unfortunately, the observed auto-correlations may also be positive, detracting from that measure’s validity.

Hasbrouck (1991) uses a systems approach for the representation of price changes, based on autocorrelations and cross-correlations. In other words, a VAR approach is adopted with the goal of extracting the information contained on stock trades. As in LOT, the occurrence of price changes (nonzero returns) is crucial to the analysis, since, in addition to what is referred to as an explicit cost in the present article, the presence of information asymmetries would cause a permanent change in prices.

Such a change is due, along with micro-structural restrictions to trading, to the impact of trading on prices. This has become known as a “market impact factor”. Hasbrouck (1991) endeavors to separate transitory from permanent effects and is more concerned with the latter.

One of his results indicates that the impact of information asymmetries is more important for smaller firms. This is an additional justification for testing a hypothesis on the relationship between firm size and transactions costs implicit in price changes. However, Hasbrouck (1991) uses individual transaction data, including data on the quantity traded in each transaction. In the present article, the methodology used does not require that type of more detailed information.

The fifth measure, developed by Lesmond et al. (1999), heretofore referred to as LOT, also uses price behavior information. This is the measure used in the present article, formally described in the next section. To summarize, the LOT measure is able to produce directly a rate as an estimate of transactions costs, including not only the spread charged for information asymmetry and adverse selection, but also the direct brokerage costs and taxes, as well as the possible price impact costs. Hence, this rate combines all types of costs, which are implicit in the prices at which trades take place. As put by Lesmond (2005, p. 424): “LOT... provides an estimate of liquidity encapsulating spread effects, price impact effects, and market depth influences”.

Lesmond (2005) analyzes the explanatory power of the various measures described above for 23 emerging stock markets, using as dependent variable a direct measure of transactions costs, namely the observed bid-ask spread. Due to data limitations, that study uses quarterly spreads. The period ranges from 1993 to 2000 and the results point to the superiority of the LOT measure.

In the original application of their methodology, Lesmond et al. (1999) used daily returns of all stocks traded at the New York Stock Exchange (NYSE) and the American Stock Exchange (AMEX) in the 1963–1990 period. The authors obtained costs ranging, on average, from 1.2% to 10.3% for firms included in the
top and bottom deciles by firm size. These values correspond to round trip costs, that is, purchase plus sale costs in a given transaction. The values were estimated on the basis of daily closing prices. It was also determined that the correlation between their measure of transactions costs and the usual measures, such as the difference between bid and ask quotes, was equal to 0.88.

This means that such a methodology may be considered as a good substitute for market efficiency and microstructure studies when such spreads are not easily known, as is the case in Brazil, in which the use of a market making regime is not dominant.

In LOT, however, the main concern was not with explaining differences among the various stocks in terms of transactions cost, but simply to justify the validity of a new estimation method. At any rate, the association uncovered between firm size and estimated transactions costs is treated in the present article as a hypothesis to be tested with Brazilian market data.

Also concerned with the presence of transactions costs in the Brazilian stock market, Barbedo et al. (2009) employed the probability of informed trading (PIN) technique, originally proposed by Easley et al. (1996). In that application, the idea is that, the higher the estimated probability, the greater the risk of trading against an investor holding superior information about an asset’s intrinsic value. The authors analyzed a cross section of 48 stocks using intraday data, that is, individual transaction data, in the BM&FBovespa market from January 2, 2001 to June 20, 2006. The calculation of average probabilities in that period, for each sample stock, led them to test hypotheses about the influence of corporate governance levels and liquidity variables.

Although their results confirm, to a certain extent, the expectation that superior governance firms (especially those in the New Market category) would involve lower probabilities of informed trading, that is not the article’s strongest result. The article finds that the relationship between probabilities and individual stocks’ liquidity causes the firms in the traditional segment, normally larger and more liquid, to be associated with even lower probabilities than those for New Market companies.

For this reason, the present article also considers, in order to explain differences in terms of transactions costs, the two characteristics used in Barbedo et al. (2009), namely, the issuing firm’s level of corporate governance and a measure of its stock’s liquidity.

3. Model and Methodology

The model used in the present article for the purpose of measuring transactions costs, as developed by LOT, is predicated on the availability of daily returns series, and does not resort directly to information on brokerage fees, taxes or bid-ask spreads that should reflect, according to Stoll (1989), a premium charged by the market maker for operating under asymmetric information.
The basic ingredient of this approach is the possibility of daily returns equal to zero, in other words, trades in which no price changes are observed, and their inclusion in the return generating process, as described below.

If there were no transactions costs, investors could trade continuously. Given that such costs are not equal to zero, the marginal investor will compare the transactions costs to expected gains. It is reasonable to say that such a marginal investor will be that investor for which the difference between the value of information and transactions costs is maximized.

According to LOT and Glosten & Milgrom (1985), we assume the existence of publicly available information that investors can use in order to expand their information set and help them in their decision whether to trade or not. In addition, according to LOT, the main determining factor in price changes will be information-based trading, and not trading due to mere liquidity needs.

Therefore, it is presumed that a price change will be observed when the buyer or the seller holds information whose value is at least equal to that price change. Thus, the basic assumption says that, when a zero return is observed, that is, a trade took place with no change in price, it is because the level of transactions cost was not overcome, and that trade was not motivated by the use of relevant information, either favorable or unfavorable.

One uses a model for the generation return process in the presence of transactions costs, in turn based on the Tobin (1958) analysis of limited dependent variables discussed in Maddala (1983).

The assumption is that the so-called “market model” is the appropriate linear generating process for daily returns, but without the intercept. When transactions costs exist, the marginal informed investor will trade only if the value of information is above transactions costs. Hence, the market model intercept will be included in the estimated intercepts.

The proposed model for the relationship between stock j’s observed returns at date t, \( R_{jt} \), and true returns, \( R^*_jt \), is given by:

\[
R^*_jt = \beta_j R_{mt} + \epsilon_{jt} \tag{1}
\]

where \( R_{mt} \) is the date t observed return on the market portfolio, and:

\[
R_{jt} = R^*_jt - \alpha_{1j} \text{ if } R^*_jt < \alpha_{1j} \tag{2}
\]
\[
R_{jt} = 0 \text{ if } \alpha_{1j} < R^*_jt < \alpha_{2j} \]
\[
R_{jt} = R^*_jt + \alpha_{2j} \text{ if } R^*_jt > \alpha_{2j} \]

In words, for stock j, the limit for the transactions cost in the use of unfavorable information is \( \alpha_{1j} \), and for trades with favorable information the limit is \( \alpha_{2j} \). If true returns, that is, \( R^*_jt = \beta_j R_{mt} + \epsilon_{jt} \) are within those two limits, the observed return for stock j on day t will be equal to zero, and observed trades will have liquidity purposes only. It will then be concluded that the value of liquidity is superior to transactions costs.
The likelihood function that corresponds to that model has three components associated with the observed returns: one is associated with negative returns, another with positive returns, and the third component is associated with observed returns equal to zero:

$$L_j = \prod_{t \in R_1} (1/\sigma_j) \phi(\varsigma_t) \prod_{t \in R_0} P(\text{return} = 0)$$  \hspace{1cm} (3)$$

$R_1$ and $R_2$ are the regions in which observed returns, $R_{jt}$, are different from zero, conditional on negative and positive returns on the market index, respectively, and $R_0$ is the region of returns equal to zero. The symbols $\phi_1$ and $\phi_2$ represent the density functions of the standard normal distribution, respectively, for negative and positive observed returns. That is, they correspond to standard residuals, calculated by $\varsigma = \epsilon/\sigma$, where $\sigma^2$ is the variance estimated with the use only of nonzero observed returns. $P(\text{return} = 0)$ denotes the probability that observed returns are equal to zero.

Using the definitions for the set of equations (2), and calculating the logarithm of the likelihood function, we obtain:

$$\ln L_j = \sum_1 \ln(2\pi\sigma_j^2)^{-1/2} - \sum_1 [(1/2\sigma_j^2)(R_{jt} + \alpha_{1j} - \beta_j R_{mt})^2]$$

$$+ \sum_2 \ln(2\pi\sigma_j^2)^{-1/2} - \sum_2 [(1/2\sigma_j^2)(R_{jt} + \alpha_{2j} - \beta_j R_{mt})^2]$$

$$+ \sum_0 \ln(\phi_{j2} - \phi_{j1})$$ \hspace{1cm} (4)$$

where $\phi_{j2}$ and $\phi_{j1}$ are the distribution functions for the standard normal probability distribution corresponding, respectively, to the observed returns in regions $R_2$ and $R_1$.

The parameters $\alpha_{1j}$, $\alpha_{2j}$, $\beta_j$ are estimated by the maximization of the likelihood function in equation (4), and the estimated transactions cost (the “LOT measure”) for each stock $j$ are equivalent to the difference between the estimated values of the two intercept terms. More precisely:

$$\text{Estimated transactions cost for stock } j = \hat{\alpha}_{2j} - \hat{\alpha}_{1j}$$  \hspace{1cm} (5)$$

We discuss the values for estimated transaction cost in the presentation and analysis of the results that follow.

In Lesmond (2005), an application of that methodology was used for measuring the correlation with the usual estimate of transactions cost (bid-ask spread plus brokerage fees) in several emerging markets, including Brazil.

In the case of the data for Brazil, the author used quarterly spreads and obtained a correlation coefficient of 0.48 with his measure of transactions cost. The author points out, as a limitation of the method applied in the present article, that the...
daily data used may not contain more than 80% of returns equal to zero and/or nonexistent returns (an indication that there were no trades of a given stock on a given day).

For that reason, the present article uses stocks with at least 100 observed returns for each year in the sample period. In the worst case, this excludes slightly under 25% of the collected data.

Lesmond (2005) analyzes data for 23 emerging markets in the 1993–2000 period. He observes a significant increase in the estimated transactions costs between the third quarter of 1997 and the third quarter of 1998, coinciding with the Asian and Russian crises. For a similar reason, the present article includes a hypothesis involving the impact of the global financial crisis commonly centered at the time of the Lehman Brothers bankruptcy in the second half of 2008.

In a test of the determinants of the cost of liquidity, measured by bid-ask spreads, in a comparison with the LOT measure and other competitors (Roll (1984), Amihud & Mendelson (1986), Amihud (2002); and turnover), Lesmond (2005) also includes each stock’s volatility as an explanatory variable. In general, the results are positive and significant coefficients, particularly for the Brazilian market. For this reason, this article also includes the hypothesis of a direct association between volatility and estimated transactions cost.

In turn, the PIN approach contains two glaring disadvantages: (a) the need for a very large volume of data, requiring access to trade-by-trade data, (b) the fact that the resulting measure does not correspond directly to a cost estimated, not lending itself easily to assessments of market efficiency as the LOT measure.

4. Tests of Hypotheses and Data Used

Daily return data for stocks traded in the Bovespa segment of the BM&FBovespa, available in the Economática data base were used. The data cover the period from January, 1999 to December, 2009. Only the stocks traded in at least 100 of the approximately 250 trading sessions in each year were included in the sample. Daily returns were calculated by the logarithm of closing price ratios.¹

As highlighted in the description of the methodology, the basic data need for the analysis undertaken in the present article consist of daily returns on individual stocks and on a market index. Table 1 provides basic annual statistics for the sample data: average, median, and standard deviation for the estimated transactions cost for all stocks contained in a given year’s sample. The number of individual stocks analyzed in each year is also indicated in the last column.

¹As pointed out by an anonymous referee, the BM&FBovespa offers the registered market makers an exemption from exchange fees when these intermediaries maintain limited bid-ask spreads. Since the nature of the data available does not indicate whether the trades were executed directly with a market maker as counterparty, it is not possible to adjust the prices and returns for this fact.
Table 1
Descriptive statistics for estimated transactions cost (%) and number of stocks in each year’s sample, 1999-2009

<table>
<thead>
<tr>
<th>Year</th>
<th>Average transactions cost</th>
<th>Median transactions cost</th>
<th>Standard deviation of individual transactions costs</th>
<th>Maximum cost</th>
<th>Minimum cost</th>
<th>Number of stocks with at least 100 daily returns observed in each year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>0.0295</td>
<td>0.0177</td>
<td>0.0345</td>
<td>0.233</td>
<td>0.0001</td>
<td>242</td>
</tr>
<tr>
<td>2000</td>
<td>0.0197</td>
<td>0.0124</td>
<td>0.0193</td>
<td>0.1000</td>
<td>0.0005</td>
<td>222</td>
</tr>
<tr>
<td>2001</td>
<td>0.0207</td>
<td>0.0135</td>
<td>0.0252</td>
<td>0.1984</td>
<td>-0.0224</td>
<td>196</td>
</tr>
<tr>
<td>2002</td>
<td>0.0220</td>
<td>0.0140</td>
<td>0.0275</td>
<td>0.1692</td>
<td>-0.0001</td>
<td>181</td>
</tr>
<tr>
<td>2003</td>
<td>0.0194</td>
<td>0.0109</td>
<td>0.0218</td>
<td>0.2126</td>
<td>-0.0273</td>
<td>192</td>
</tr>
<tr>
<td>2004</td>
<td>0.0159</td>
<td>0.0100</td>
<td>0.0328</td>
<td>0.1492</td>
<td>-0.0289</td>
<td>209</td>
</tr>
<tr>
<td>2005</td>
<td>0.0143</td>
<td>0.0081</td>
<td>0.0187</td>
<td>0.0822</td>
<td>0.0000</td>
<td>215</td>
</tr>
<tr>
<td>2006</td>
<td>0.0129</td>
<td>0.0058</td>
<td>0.0155</td>
<td>0.1079</td>
<td>-0.0255</td>
<td>236</td>
</tr>
<tr>
<td>2007</td>
<td>0.0137</td>
<td>0.0071</td>
<td>0.0153</td>
<td>0.0685</td>
<td>-0.0181</td>
<td>349</td>
</tr>
<tr>
<td>2008</td>
<td>0.0136</td>
<td>0.0084</td>
<td>0.0146</td>
<td>0.0621</td>
<td>-0.0282</td>
<td>338</td>
</tr>
<tr>
<td>2009</td>
<td>0.0122</td>
<td>0.0065</td>
<td>0.0118</td>
<td>0.0883</td>
<td>-0.0483</td>
<td>316</td>
</tr>
</tbody>
</table>

Overall, the series of estimated transactions costs, as reported in Table 1, indicates a decline and, thus, an increase in the efficiency of trading in the Brazilian stock market over the sample period, particularly from 2003 on. In addition, one notes a reduction in the dispersion of estimated costs from the beginning to the end of the period.

However, an increase in median costs is observed for 2008, possibly resulting from the global financial crisis in the second half of that year. A similar increase is observed in 2007, at the end of the initial public offer “wave” which began in 2004. It is also possible that the inclusion of numerous new firms in the market would have increased the general level of information asymmetry faced by market participants.

The subsequent econometric analysis includes and emphasizes the possible explanations associated with the characteristics of each issuing firm, as well as the impact of the 2008 crisis on estimated transactions costs.

For that purpose, the following explanatory variables are defined, along with the corresponding hypotheses:

**Participation in ADR programs:** This was represented by another binary variable, indicating the issuing firm’s participation in an ADR program, at least at level II, implying the listing and trading of its stock in a U.S. stock market. Since U.S. regulatory agencies are believed to be more demanding in terms of information disclosure to investors, an inverse relationship is expected between this variable and transactions cost.

**Level of corporate governance:** A set of binary variables were used for representing each of the governance categories defined by the BM&FBovespa: New Market, Level 1, Level 2, Traditional. This last segment received a value of zero in all cases. Since one of this program’s main goals is to foster transparency regarding each issuer, one expects an inverse relationship between governance and transac-
Specific information regarding the inclusion of each firm in the various governance levels were obtained from the BM&FBovespa website at http://www.bmfbovespa.com.br/cias-listadas.

Regarding these variables, the expectation is that of an inverse relationship between differentiated governance (levels 1 and 2 and New Market, compared with the Traditional segment), in addition to a more negative association the higher the level of differentiated governance.2

**Issuing firm size:** This variable was included as an attempt at confirming results originally obtained by LOT for the U.S. market. Firm size was measured in each year by the firm’s enterprise value (EV) available in Economática, that is, the market values of all classes of stock plus the book value of the firm’s net debt. As in LOT, an inverse relationship is expected between firm size and transactions cost.

**Stock volatility:** According to Stoll (2000), a stock’s volatility is a reflection of the risk of unfavorable price changes for stocks held in inventory by market makers. It can also be argued that a stock’s volatility directly reflects the uncertainty regarding the asset’s fundamentals. Hence, the expected relationship between volatility and estimated transactions cost is a direct one. Each individual stock’s volatility was measured by the stock’s daily returns for each year in the sample period. As mentioned previously, this involved at least 100 daily returns.

**Stock liquidity:** It is assumed that, the more frequently a stock is traded, tending to involve a larger number of participants in its market, the greater the ease with which new relevant information is impounded in its market price, thereby reducing the scope for information asymmetry. Originally, the inclusion of a measure of trading volume as a determinant of the cost of liquidity came up in Stoll (2000), who argued that trading volume is a proxy for a stock’s available inventory. A larger inventory would facilitate the emergence of a counterpart to a trade, therefore reducing transactions cost. The same would be true, according to Stoll (2000), for the size of the issuing firm.

In the present article, four possible measures of an individual stock’s liquidity were easily accessible: the number of securities traded, the number of trades, the financial volume of trading, and a combination of the number of trades and the financial volume involved, all measured in the span of one year and relative to the overall market.

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2The strictest level is that of the New Market, followed by Level 2, and finally Level 1. The Traditional segment includes those firms which are said not to have “differentiated corporate governance.”
The last measure, known as the “negotiability” index, as computed by the BM&FBovespa, was an inappropriate measure, for the following reason: when the number of trades increases, and so does the number of securities traded, the ratio would remain stable.

For a market in which programmed trading leads to a smaller increase in volume of trading, relative to that in the number of trades, liquidity would have expanded, and still the negotiability index would not show it.\(^3\)

After discarding the negotiability index as a proxy for liquidity, the other three measures were experimented with, when testing for the assumed inverse relationship between liquidity and transactions cost.

**CPMF:** During part of the 1999-2009 period, transactions involving financial assets were subject to a so-called “temporary” tribute known as CPMF (the “temporary contribution on financial asset transactions”). Specifically, this contribution was charged at a rate that varied from 0.20% to 0.38% of the monetary value of any transaction involving financial assets, such as stocks. This contribution was in force between 1999 and 2002. This control variable was included in order to determine whether the much maligned impact of this tax was indeed significant.

As indicated, the data required by this study were obtained entirely from the Economática database or the BM&FBovespa website.

5. **Econometric Modelling**

The specification used for testing all the aforementioned hypotheses was as follows:

\[
\text{Cost}_{jt} = \beta_0 + \beta_1 \text{ADR}_{jt} + \beta_2 \text{CPMF} + \beta_3 D08 + \beta_4 \text{DN}_{1,j,t} + \beta_5 \text{DN}_{2,j,t} + \beta_6 \text{DNM}_{jt} + \beta_7 \text{TRADES}_{jt} + \beta_8 \text{SIZE}_{jt} + \beta_9 \text{VOLAT}_{jt} + \epsilon_{jt}
\]

where:

- \(\text{ADR}_{jt} = 1\) if firm \(j\) participates in an ADR program at least at level II in year \(t\), 0 otherwise;
- \(\text{CPMF} = 1\) for all stocks in years \(t\) from 1999 to 2002, 0 otherwise;
- \(D08 = 1\) for all stocks in year \(t = 2008\), 0 otherwise; this variable is included in an attempt to determine what impact the global financial crisis had on transactions costs in the BM&FBovespa stock market;
- \(\text{DN}_{1,j,t} = 1\) if firm \(j\) is included in the BM&FBovespa governance Level 1 in year \(t\), 0 otherwise;
- \(\text{DN}_{2,j,t} = 1\) if firm \(j\) is included in the BM&FBovespa governance Level 2 in year \(t\), 0 otherwise;
- \(\text{DNM}_{jt} = 1\) if firm \(j\) participates in an ADR program at level III in year \(t\), 0 otherwise;
- \(\text{TRADES}_{jt} = 1\) if firm \(j\) participates in an ADR program at level IV in year \(t\), 0 otherwise;
- \(\text{SIZE}_{jt} = 1\) if firm \(j\) participates in an ADR program at level V in year \(t\), 0 otherwise;
- \(\text{VOLAT}_{jt} = 1\) if firm \(j\) participates in an ADR program at level VI in year \(t\), 0 otherwise;

\(^3\)I thank an anonymous referee for pointing this out. In fact, in the 1999-2009 period, the rates of increase in number of trades, the number of securities traded and the volume of trading were, respectively, 37.6%, 6.7%, and 24.6%.
\(DN_{2,j,t} = 1\) if firm \(j\) is included in the BM&FBOVESPA governance Level 2 in year \(t\), 0 otherwise;

\(DN_{NM,j,t} = 1\) if firm \(j\) is included in the BM&FBOVESPA New Market governance Level in year \(t\), 0 otherwise;

\(TRADES_{j,t}\) = ratio of the number of trades involving stock \(j\) in year \(t\), to the total number of trades of all stocks in year \(t\);

\(SIZE_{j,t}\) = firm \(j\)’s enterprise value (EV) in year \(t\), measured in R$ million;

\(VOLAT_{j,t}\) = standard deviation of stock \(j\)’s daily returns in year \(t\).

All classes of stock outstanding of any firm \(j\) are included in the sample, so as to have a representative sample as possible of the Brazilian stock market. The only restrictions are associated with the need for having at least 100 daily returns available for any stock in any year, in addition to the existence of information for all other variables in equation (6).

In accordance to the previous discussion of the various variables’ role, the following hypotheses were tested:

**Participation in ADR programs:** the null hypothesis is \(\beta_1 \geq 0\), and the alternative hypothesis is \(\beta_1 < 0\) (firms involved in such programs are required to disclose more information, and this reduces the costs of trading their stock).

**CPMF:** the existence of a positive tax on financial transactions in 1999-2002 is equivalent to an explicit transactions cost that may have affected overall cost. The null hypothesis is \(\beta_2 \leq 0\), and the alternative hypothesis is \(\beta_2 > 0\).

**2008 crisis:** the null is \(\beta_3 \leq 0\), and the alternative is \(\beta_3 > 0\). The 2008 market-wide crisis, by increasing the uncertainty about stocks’ intrinsic values, would have contributed to the enhancement of information asymmetry about those values, thereby increasing transactions cost in general, in that year.

**Participation in Superior Governance Programs:** for all the \(\beta_4\) to \(\beta_6\) coefficients, the null hypothesis is that of a non negative sign, and the alternative hypothesis is that the signs are negative, representing lower transactions costs than those for stocks of firms in the Traditional segment. In other words, adherence to stricter governance requirements would lead to greater transparency, with a reduction in transactions costs to the lower information asymmetry. It is also expected, for the same reason, that the module of estimated \(\beta_6\) will be greater than the modules of the coefficients for DN1 and DN2.

**Liquidity:** the null hypothesis is \(\beta_7 \geq 0\), with the alternative being \(\beta_7 < 0\) (stocks that are more frequently traded involve greater investor participation and lead to the faster impounding of relevant information, which leads to lower transactions cost).
**Firm size:** the null is $\beta_8 \geq 0$, and the alternative is $\beta_8 < 0$ (larger firms are more intensively followed by analysts and investors, thereby reducing stock transaction costs).

**Volatility:** the null is $\beta_9 \leq 0$, and the alternative hypothesis is $\beta_9 > 0$, because riskier stocks produce greater uncertainty for trade participants, with a resulting increase in transactions cost.

Table 2 provides information on the annual evolution of the sample averages of each independent variable used in the model, with the obvious exception of the dummy variables for the existence of the CPMF and the occurrence of the 2008 crisis.

**Table 2**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>STOCKS</th>
<th>ADR</th>
<th>DN1</th>
<th>DN2</th>
<th>DNM</th>
<th>SIZE</th>
<th>VOLAT</th>
<th>TRADES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>242</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2340.09</td>
<td>0.0311</td>
<td>0.0035</td>
</tr>
<tr>
<td>2000</td>
<td>222</td>
<td>27</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3363.78</td>
<td>0.0425</td>
<td>0.0034</td>
</tr>
<tr>
<td>2001</td>
<td>196</td>
<td>30</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>3876.18</td>
<td>0.0449</td>
<td>0.0037</td>
</tr>
<tr>
<td>2002</td>
<td>181</td>
<td>36</td>
<td>26</td>
<td>2</td>
<td>7</td>
<td>4777.77</td>
<td>0.0394</td>
<td>0.0053</td>
</tr>
<tr>
<td>2003</td>
<td>192</td>
<td>37</td>
<td>33</td>
<td>5</td>
<td>14</td>
<td>5968.01</td>
<td>0.0518</td>
<td>0.0143</td>
</tr>
<tr>
<td>2004</td>
<td>209</td>
<td>39</td>
<td>44</td>
<td>5</td>
<td>4</td>
<td>7103.05</td>
<td>0.0328</td>
<td>0.0046</td>
</tr>
<tr>
<td>2005</td>
<td>215</td>
<td>38</td>
<td>43</td>
<td>8</td>
<td>14</td>
<td>8410.05</td>
<td>0.0313</td>
<td>0.0045</td>
</tr>
<tr>
<td>2006</td>
<td>236</td>
<td>37</td>
<td>52</td>
<td>10</td>
<td>28</td>
<td>9515.24</td>
<td>0.0336</td>
<td>0.0041</td>
</tr>
<tr>
<td>2007</td>
<td>349</td>
<td>35</td>
<td>61</td>
<td>14</td>
<td>70</td>
<td>9581.41</td>
<td>0.0425</td>
<td>0.0056</td>
</tr>
<tr>
<td>2008</td>
<td>338</td>
<td>36</td>
<td>62</td>
<td>20</td>
<td>86</td>
<td>8529.37</td>
<td>0.0483</td>
<td>0.0042</td>
</tr>
<tr>
<td>2009</td>
<td>316</td>
<td>35</td>
<td>99</td>
<td>19</td>
<td>91</td>
<td>8828.01</td>
<td>0.0361</td>
<td>0.0029</td>
</tr>
</tbody>
</table>

ADR = number of stocks involved in ADR programs at least at level II; DN1 = number of firms in BM&FBovespa’s corporate governance level 1; DN2 = number of firms in BM&FBovespa’s corporate governance level 2; DNM = number of firms in BM&FBovespa’s New Market corporate governance level; SIZE = enterprise value (market value of all classes of stock + accounting value of the firm’s net debt at the end of the year, in R$ million); VOLAT = standard deviation of daily returns on stock $j$ during the year; TRADES = ratio of number of trades in stock $j$ during year $t$ to the total number of trades of all market stocks in year $t$.

Although the annual samples vary both in terms of size and composition, the data in Table 2 allow us to note the following: (a) ignoring the first year in the series, average volatility peaked in 2008, the height of the global financial crisis; (b) the explosive growth in the number of firms in the New Market group of superior governance organizations, particularly in 2007, when there was a surge in IPOs and most of the firms involved were listed in that category; (c) the stability in the number of firms participating in ADR programs, which generally involve mature firms at Level 2 or the Traditional segment of the BM&FBovespa; (d) a reduction in the values of the liquidity measure (TRADES), indicating a reduction in the concentration of trading at the exchange, especially from 2007, when many new firms went public; (e) the reduction in the average value of sample firms in 2008, probably due to the sharp reduction in equity market values caused by the financial crisis.
The results in Table 3 indicate that the partial association with the dependent variable (COST) is strongest with stocks’ volatilities, and the correlation is positive, as expected. The negative partial correlations of all the governance variables, including ADR, with COST are also as expected. The same is true for both the proxy for liquidity (TRADES) and the firm size measure.

The ADR and SIZE variables, which can be interpreted as indicators of a firm’s “quality” are positively and highly correlated. This positive correlation is as expected, since the usual participant in an ADR program tends to be a mature firm, with sufficient resources for meeting the information production and disclosure costs of program participation.

The correlation between SIZE and TRADES is also positive and significant. Usually, the firms in the Traditional listing segment of the BM&FBovespa are larger and more mature firms. These firms tend to attract wider analyst coverage, which encourages more frequent trading and higher liquidity. In the approach adopted in the present article, it is the recognition of such a possibility that leads to explaining the results in Barbedo et al. (2009).

6. Test Results

The various hypotheses were tested with a panel estimator, with fixed effects. Standard errors were corrected for heteroscedasticity by the White cross section coefficient covariance method. The results are provided in Table 4.
Table 4
Results for the estimation of partial versions and the full version of the model proposed in equation (6)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Full Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.0008</td>
<td>0.0009</td>
<td>0.0037</td>
<td>0.0020</td>
</tr>
<tr>
<td>ADR</td>
<td>-0.0005</td>
<td>-6.94E-05</td>
<td>9.54E-05</td>
<td></td>
</tr>
<tr>
<td>CPMF</td>
<td>0.0026</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D2008</td>
<td>-0.0067*</td>
<td>9.54E-05</td>
<td>-0.0067*</td>
<td></td>
</tr>
<tr>
<td>DN1</td>
<td>-0.0001</td>
<td>-0.0002</td>
<td>-0.0001</td>
<td></td>
</tr>
<tr>
<td>DN2</td>
<td>-0.0002</td>
<td>-0.0002</td>
<td>-0.0002</td>
<td></td>
</tr>
<tr>
<td>DN3</td>
<td>-0.0101</td>
<td>-0.0111</td>
<td>-0.0101</td>
<td></td>
</tr>
<tr>
<td>TRADES</td>
<td>-0.2675*</td>
<td>-0.2689*</td>
<td>-0.2581*</td>
<td>-0.3059*</td>
</tr>
<tr>
<td>SIZE</td>
<td>-1.64E-08</td>
<td>-1.50E-08</td>
<td>-1.94E-09</td>
<td>-1.35E-08</td>
</tr>
<tr>
<td>VOLAT</td>
<td>0.4696*</td>
<td>0.4694*</td>
<td>0.4535*</td>
<td>0.4804*</td>
</tr>
</tbody>
</table>

Using the results displayed in Table 4, Table 5 summarizes them in terms of the inferences that can be made regarding the various hypotheses tested herein.

Table 5
Inferences regarding the various hypotheses proposed, using the results obtained with the full model, as reported in table 4

<table>
<thead>
<tr>
<th>Variable</th>
<th>Inference on the corresponding null hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADR</td>
<td>H0 not rejected</td>
</tr>
<tr>
<td>CPMF</td>
<td>H0 not rejected</td>
</tr>
<tr>
<td>D2008</td>
<td>H0 not rejected</td>
</tr>
<tr>
<td>DN1</td>
<td>H0 rejected</td>
</tr>
<tr>
<td>DN2</td>
<td>H0 not rejected</td>
</tr>
<tr>
<td>DN3</td>
<td>H0 rejected</td>
</tr>
<tr>
<td>TRADES</td>
<td>H0 not rejected</td>
</tr>
<tr>
<td>SIZE</td>
<td>H0 not rejected</td>
</tr>
<tr>
<td>VOLAT</td>
<td>H0 rejected</td>
</tr>
</tbody>
</table>

The last column, the conclusion “H0 rejected” denotes rejection of the null hypothesis in favor of the alternative for each variable discussed above, at the 1% significance level.

As the preceding results indicate, there appears to be solid evidence against the relevance of a firm’s size as an important determinant of transactions costs. Given the high positive correlation with the liquidity measure (TRADES), it may be the case that larger firms tend to be traded more intensively, as a result of their larger

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capitalization. This would lead us to believe that size determines liquidity, and that the possible significance of size is already captured by liquidity.

In comparison with previous results in the literature, such as those in Lesmond (2005), that is the only major difference, since both liquidity and volatility are both significantly associated with transactions costs, positively in the case of volatility and negatively in the case of liquidity, as expected. This can be observed in the results for all versions of the model. In particular, they are robust to changes in specification.

In turn, participation in ADR programs adds no significant influence as a determinant of transactions costs. This is indicated in the results for Models 2, 3 and the Full Model. This result was not expected, but may be caused by ADR being proxied for by the liquidity measure.

The impact of superior governance, explicitly controlled for liquidity, both in Model 3 and the Full Model, is as expected: higher level of corporate governance induces lower transactions costs, presumably as a result of the demands for greater transparency the exchange. Also as expected, the impact in terms of a reduction in transactions costs is stronger for the stocks of firms in the New Market category. This is indicated by the more negative coefficients obtained for the DNM variable, relative to those of the DN1 and DN2 variables.

One interesting result is that for the dummy variable included to account for the possible effect of the 2008 crisis. Apparently, in that year the overall level of transactions costs was lower, in spite of, or because of the crisis. The data in Tables 1 and 2 did not point to any special increase in transactions costs (Table 1) or any impact on liquidity (Table 2) in 2008. In that year, according to Table 1, volatility was higher than in any other year, with the exception of 1999. It is reasonable to consider that the crisis was responsible for the increase in market volatility. However, the impact on transactions costs is already being accounted for by the inclusion of the VOLAT variable.

7. Conclusion

The article’s most distinctive results, given its objective, is the importance of the governance mechanisms as determinants of total (both explicit and implicit) transactions costs. It is possible that the overall level of transactions costs may have declined in the period, thanks to lower brokerage fees. These are costs that clearly affect all stocks and firms. However, it is clear that the stocks of firms listed in governance classes that demand greater transparency are traded at lower costs. This can only be attributed to lower implicit costs.

In addition, the literature posits other important influences on transactions costs, especially volatility and liquidity. Volatility may be seen as a measure of uncertainty about a stock’s intrinsic value and/or its price sensitivity to the arrival of new information. These effects widen the scope for information asymmetry.

In turn, higher liquidity implies active market participation by more agents and/or the more frequent observation of security revaluations through price
changes. These effects possibly lead to better impounding of relevant information and more limited information asymmetry. The expected results for both volatility and liquidity were strongly confirmed with Brazilian data.

In addition to providing a direct estimated of transactions costs, the present article provided results which are somewhat distinct from those obtained with the PIN approach in Barbedo et al. (2009). The results obtained herein allow us to distinguish with clarity the partial contribution of superior governance segment listing as opposed to liquidity. As initially, pointed out, these two factors were not disentangled in the Barbedo et al. (2009) analysis.

As another contribution to the literature on the Brazilian stock market, the present article demonstrated the feasibility of the direct estimation of transactions costs, thanks to the use of the LOT approach. The econometric, computational and data demands of the LOT approach are significantly lower than those of the PIN approach.

In terms of future work possibilities, a matter for further exploration is the result obtained for the impact of the 2008 crisis on transactions costs. Possibly, a better variable specification or additional reflection on whether a market crisis can increase or reduce such costs would help us understand this phenomenon more appropriately.

Finally, and this remains as a matter for future research, the use of an approach, such as that involving Kalman filters, in which true returns would be directly estimated, leading to the estimation of transactions costs by the computation of the difference between estimated true returns and observed returns.

References


