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Impact of a New Benchmark on the OTC Market: Evidence from Brazil
Impacto de um Novo Benchmark no Mercado de Balcão Brasileiro

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Resumo

Esta dissertação pode ser dividida em duas principais partes. Na primeira, nós analisamos os efeitos da publicação de um novo benchmark no mercado de aluguel de ações. Na segunda, nós utilizamos as descobertas obtidas na primeira parte para criar um instrumento que nos permite avaliar a relação entre a venda a descoberto e duas características do mercado à vista: eficiência de preço e liquidez. O estudo é baseado em uma base de dados com todas as negociações de empréstimo de ações em um período de 60 dias em torno da implementação do novo benchmark, contendo 162.195 negócios de 279 ações. Nós apresentamos três principais achados. Primeiro, a publicação do benchmark resultou em uma queda geral das taxas de empréstimos, e uma diminuição da dispersão da taxa de empréstimo e de corretagem. Segundo, o impacto nas taxas de empréstimo foi mais alta para ações com histórico de alta volatilidade, alta taxa de empréstimo média, e baixo número de tomadores por dia. Terceiro, restrições às operações de venda a descoberto - mensuradas pela variação exógena das taxas de empréstimo - estão associadas com menor eficiência de preços, e a um resultado inconclusivo em relação à liquidez de mercado.

Palavras-chaves: benchmark, taxas de empréstimo e corretagem, mercados opacos, eficiência de preço, liquidez

Abstract

This paper can be divided in two main parts. First, we analyze the effects of the publication of a new benchmark on the Brazilian stock lending market. In the second part, we use the findings provided by the first analysis to create an instrument to assess the relation between short-selling and two characteristics of the spot market: price efficiency and stock liquidity. The study is based on a unique data set of all the loan contracts for a 60-day window around the introduction of the benchmark, containing the information of 162,195 deals of 279 tickers. We present three main findings. First, the publication of the new benchmark caused an overall reduction in average loan fees, and a narrowing of loan and brokerage fee dispersion. Second, the impact on loan fees was higher for tickers with a history of high volatility, high average loan fee and low average number of borrowers per day. Third, short-selling constraints - measured by the exogenous variation of loan fees - are associated with lower price efficiency, and an inconclusive result for market liquidity.

Key-words: benchmark, loan and brokerage fees, opaque markets, price efficiency, liquidity

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1 Introduction

This paper can be divided in two main parts. In the first, we analyze the effects of the publication of a new benchmark on the Brazilian stock lending market. In the second part, we use the findings provided by the first analysis to create an instrument to assess the relation between short-selling and two characteristics of the spot market: price efficiency and liquidity. As the results obtained contribute for two distinct literature, the introduction section is divided in two subsections, one for each main part of this article.

1.1 Benchmark analysis

The potential outcome of changing the transparency[1] level of financial markets remains an important topic in political debates and academic research. In particular, the introduction of benchmarks – as one of the most common tools to reduce informational asymmetry between agents – holds a prominent place in this debate. Each year, trillions of dollars are transacted on OTC markets where agents rely on benchmarks (DUFFIE; DWORCZAK; ZHU, 2017). Despite this topic's relevance, studies of changes in the transparency level of opaque markets are scarce for several reasons. First, there is the not-so-simple task of finding instances in which new benchmarks are launched in opaque markets. The second is directly related to the complexity, by definition, of obtaining data from this type of environment. Conveniently, the Brazilian stock lending market, which will be detailed in Section 2, fulfills both requirements.

In this paper we present empirical evidence of the impacts of the launch and publication of a new benchmark for Brazilian over-the-counter market in 2011. At the beginning of that year, a new benchmark was implemented, increasing the amount of transaction information available for all market players. Using a database that contains all the stock loan deals closed during time periods shortly before and after the launch, we analyze the effects on loan and brokerage fees. To do so, we use a before-and-after comparison of loan and brokerage fees with three different time windows: 20, 40, and 60 days. With these varying time lengths, we are able to analyze the results with different quantities of observations and different levels of interference from potential unobserved effects.

Our main findings are as follows. First, the new benchmark reduced the overall average loan fee by approx. 0.2 SD. Second, it squeezed the distribution of brokerage and

[1] The concept of "market transparency"is defined by O'hara (1995) as the ease of members of a market to observe the information resulting from the market's transaction process. This information can be of current and past prices, quotations, volume of transactions, among others.

loan fees, reducing the difference between higher fees and lower ones by 0.25 SD and 0.3 SD respectively. Third, with three distinct analysis we found that tickers with a history of (1) higher loan fees, (2) low number of borrowers, and (3) higher volatility had their loan fees more impacted by the new benchmark implementation.

These findings have implications for short-sellers, brokers, and regulators. Short-sellers directly depend on the cost of loan fees to create their portfolio strategies - any changes in this cost have impacts on the decisions they make. Brokers rely on a vast number of variables to define their brokerage fee on each deal and increasing market transparency can lead to more competition between them. When more information is added, lenders and borrowers could have incentives to negotiate fees and this movement can create pressure toward lowering brokerage fees. Lastly, regulators (usually responsible for implementing changes) have a vested interest in understanding the impacts of their decisions, thus it is important to verify empirically if the policy changes proposed have accomplished their desired goals.

This article is written with the benefit of past academic literature that investigates the role of transparency on market structure, in particular works that cover the impacts of the launch of new benchmarks. Papers from the past 20 years contribute to this debate, offering empirical studies and theoretical models.

From the empirical perspective, one of the most studied case is TRACE, a benchmark introduced on the American corporate bonds market, which works as an OTC market, in 2002. Bessembinder, Maxwell e Venkataraman (2006) develop a structural model to capture the impacts of TRACE on transaction costs. Using data from the National Association of Insurance Commissioners, they report a reduction of 50% and 20% on transactions cost for bonds eligible and ineligible for TRACE reporting, respectively. Edwards, Harris e Piwowar (2007) use a difference-in-differences approach to estimate transaction costs impacts on newly-issued bonds, comparing them to bonds for which there is no change in transparency. Using a database of all secondary trades in corporate bonds, they show that the transaction costs of the treated group decrease compared to each control group tested. Goldstein, Hotchkiss e Sirri (2006) use a controlled experiment of BBB-rated bonds, in which they match 90 actively traded bonds to another 90 with similar characteristics. Next, information on the first 90 bonds is made public, while such information on the matched sample is not. The authors report that the transaction costs of those transparent bonds decline relative to bonds without transparency changes. More recently, Asquith, Covert e Pathak (2013) use a new database to investigate impacts on price dispersion and trading activity. Using a difference-in-differences method, they report a significant decrease in price dispersion for all bonds, and a decrease in trading activity for some categories.

We also cite other relevant empirical work on the impacts of changes in transparency,

not necessarily on OTC markets. Madhavan, Porter e Weaver (2005) analyze the beginning of a new computerized system on the Toronto Stock Exchange, which started to publicly disseminate real-time information on the limit order book. Their results point to an increase in execution costs and volatility after the introduction of this new system. Boehmer, Saar e Yu (2005)), on the other hand, report a liquidity increase after the introduction of an NYSE service that provided limit-order book information to traders. Greenstone, Oyer e Vissing-Jorgensen (2006) study the mandatory disclosure requirements applied by the 1964 Securities Acts Amendments, in which OTC firms needed to: register with the SEC, provide regular updates on their financial position, issue proxy statements to shareholders and report insider holdings and trades. Through an event study approach, they report that newly-registered OTC firms presented positive abnormal returns after the disclosure. Finally, Jensen (2007) studies the impact of the increase in available information, due to mobile phones, on the fish market in southern India. The results point to a reduction of price dispersion and also a reduction in product waste.

From a theoretical perspective, there are several market microstructure papers which aim to understand the effects of transparency on financial markets and the mechanisms through which these changes impact trading activity[2] Madhavan (1996) show that large and informed traders benefit from opaque markets, as well as dealers who face less price competition. Pagano e Röell (1996) compare markets with different degrees of transparency and find that greater transparency results in lowering of trading cost and incentives for uninformed traders to enter that market. Bloomfield e O'Hara (1999) show that trade disclosure reduces market makers' incentives to supply liquidity, but increases the informational efficiency of transaction prices. Recently, Duffie, Dworczak e Zhu (2017) propose a model to understand, in particular, the impacts of benchmarks on OTC markets. Using an environment very similar to that studied empirically in this paper, the model shows that a benchmark can improve the match efficiency between dealers and customers, reduce search costs, and increase the trade volume. As a result, uninformed traders and low-cost dealers benefit from greater competitiveness and lower price dispersion.

1.2 Short-selling and the spot market

The impacts of short-selling constraints on financial markets are the subject of much debate among researchers and policy makers. For instance, as described in detail by Saffi e Sigurdsson (2010), after the financial crisis of 2007 regulators around the world - including USA and UK - altered short-selling regulations, restricting the short-selling of particular stocks. This actions were made to prevent, in the Securities & Exchange Commission (SEC) words, short selling from being used to drive down the share prices. The contribution of this paper lay on the study of how short-selling constraints, represented by

[2] For a literature review see Biais, Glosten e Spatt (2005)

higher loan fees, impact variables of the stock market, such as price efficiency and liquidity. The difference from our analysis to others is that we use the benchmark implementation as an instrument to overcome the endogenous relation between loan fees and stock prices. The analysis of the first stage of the benchmark as an instrument is the exhaustive study on how the benchmark's launch impacted the loan fees, performed on the first main part of this article.

After discussing the relevance of the benchmark as an instrument, we investigate the effects of short-selling on price efficiency and liquidity. We use two distinct high-frequency price efficiency indexes to measure the impact of short-selling on the price discovery process. The first index is the autocorrelation of stock returns at a 15-minute interval (AR15) as suggested in Boehmer e Wu (2012), and the second is is the Pricing Error as suggested in Hasbrouck (1993). We measure liquidity with the Amihud illiquidity index and the share's turnover. Next, we use these indexes as dependent variables to run the second-stage of our analysis in three time windows of: 20, 40, and 60 days. Overall, our results point out that higher loan fees (i.e., higher short-selling constraints) are associate with lower price efficiency. The results for liquidity do not show a clear conclusion, with increase of illiquidty by the the Amihud measure and increase of the share turnover.

There is a whole literature that seeks to assess the impacts of short-selling on the financial markets. Starting with the already cited work of Saffi e Sigurdsson (2010), which estimates panel regressions to explain cross-sectional differences in price efficiency indexes using, as proxies for short sales constraints, loan fees and lending supply. They use information of 26 countries and control for variables such as execution costs, liquidity, company size, turnover and so on. Their results indicate that stocks with limited lending supply are associated with lower efficiency. They also show that stocks with higher loan fees and lower lending supply are associated with greater downside risk and higher volatility.

With information of the New York Stock Exchange listed stocks, Boehmer e Wu (2012) use low-frequency and high frequency price efficiency indexes to study the consequences of short-selling on share prices. Their findings show that a higher volume of equity lending is related to higher informational efficiency of prices, being the short sellers important to incorporate information on prices more quickly. They also show there is no evidence that the short-selling activity is used to destabilize prices or to manipulate the market.

The work of Diamond e Verrecchia (1987) models the effects of constraints on short-sales on the speed of adjustment of security prices. In this scenario, better informed traders use short-selling and, as consequence, take stocks with bad pricing to a value closest to their fundamentals. They also explore the difference between constraints that prohibit short-selling and the ones that restrict them through higher transaction costs. The first eliminates short-sales by informed and uninformed traders alike. The second, depending

on the additional costs imposed, could demotivate the short-selling by uninformed traders or by the ones without strong beliefs of a share price decline. They also point out that the reduction of the speed of price discovery by short-selling bans, which equally constrains informed and uninformed investor, tends to increase the bid-ask spread.

Evidence provided by Boehmer, Jones e Zhang (2013) shows that short-selling bans are strictly related to lower liquidity, measured by higher bid-ask spreads. They use panel data to assess the liquidity response after a short-selling ban occurred in U.S from September 18 to October 8, exploiting the difference between stocks that had its short-selling activity banned and other who do not. In the same year, Beber e Pagano (2013) look at an international panel of stocks that were subject of shorting bans. Their conclusion is that the ban resulted in an increase of bid-ask spreads and no indicative of effects on stock prices.

From another perspective, models like the one presented by Goldstein e Guembel (2008) show that short-selling made by uninformed traders could result in profit for them, thus short positions could be made even without any real reasoning. This strategy - which they call manipulation - has impacts on the decisions of the firms, making them believe that the selling pressure is an indicative to cancel new investments. In the work of Brunnermeier e Pedersen (2005), borrowers follow a predatory strategy. In this scenario, short-selling is used by traders to sell stocks that they know another trader will sell, creating price overshooting and illiquidity. In both articles, short-selling result in less informative prices.

The remainder of this paper is structured as follows. Section 2 describes the Brazilian stock lending market, its history of changes in transparency, and the data set. Section 3 presents our empirical analysis methodology. Section 4 contains the estimation of the new benchmark's impacts on loan fees and brokerage fees, followed by the results of the relation between short-selling constraints and the variables of the spot market (price-efficiency and liquidity). Finally, our conclusions are presented in Section 5.

2 Stock lending in Brazil

The Brazilian securities lending market was responsible for moving BRL 692.5 billion in 2016, a high amount if compared to the total movement of the Brazilian stock exchange (BRL 1.84 trillion in the same year)[1]. All loan deals are closed on the Over-the-Counter market, and the contract information is only available to the agents participating in that given transactions.

The regulation of the stock lending market is done by the Brazilian Securities and Exchange Commission (CVM). The Brazilian stock exchange (B^3) acts as an intermediary between borrowers and lenders in which it is the middleman for transactions. Moreover, according to the financial laws of Brazil, all the loans should be registered with B^3; this unique aspect is fundamentally important for this research.

The collateral for all loan deals in Brazil is made using Treasury securities. So, there are no "rebate" rates and all loan deals are negotiated in terms of explicit loan fees. In our sample, the average loan fee, including all stocks, is 2.31% per year - much higher than the ones seen in markets such as the US. According to Chague et al. (2017), this difference can be explained due to the relatively higher stock market volatility in Brazil, where the higher expected volatility of asset prices and borrower costs lead to lenders charging higher loan fees.

2.1 Transparency on the stock lending market

The first stock lending transactions in Brazil were made in the 1970's. At the time, deals were closed with the agreement of borrower and lender without any regulations or intermediaries. Only in 1996 market regulations were implemented, centralizing deal making with the the Brazilian stock exchange as intermediary. Despite the institutional changes, trades continued to occur on the OTC market with virtually no transparency.

In the years that followed, the Brazilian stock exchange tried to improve stock lending market transparency at three different times, each of them starting after introducing a new benchmark.

The first one was on March 1, 2004. Implemented by using a new data query system for loan contracts, this benchmark began to publicly report the average loan fee of each stock. The calculation interval was the past 15 business days, counting from the day the broker accessed the new platform.

[1] BMF&Bovespa 2016 Balance Sheet

The second benchmark was introduced on March 1, 2011. After being announced on February 23, the benchmark started to publish the average loan fee on a 3-business-day basis, instead of 15 as before. According to BMF&Bovespa's public notice[2]:

> "...the purpose of this change is to make the securities lending market service ever more transparent, in order to attract more securities lenders and borrowers and to meet the demand of institutional investors."

Finally, the third one was published on January 28, 2014 and implemented on February 17, 2014. It made the average loan fee available for the day before the database query; furthermore, B^3 began to reveal the maximum and minimum values of loan fees traded that day.

All the information provided by B^3 as benchmarks are available online with open access. These files contain data on the number of loan contracts, number of stocks borrowed, sum of the amounts of all contracts, and the average loan fee of lender and borrower. The time period for which the information is provided varies as described above.

Due to database availability, this paper focuses on the second benchmark, and the public announcement from B^3 can be seen in the Appendix A. In addition, the data legend from B^3 in 2011, for the second benchmark, is also available as Appendix B.

2.2 Data set

Our data set is composed by the totality of equity loan contracts registered in BMF&BOVESPA system closed in Brazil, from January 31, 2011 to March 31, 2011. This data range contains 162,195 deals and 279 tickers. Each line corresponds to one loan contract and has information on the stock traded, loan quantity, loan fee (from the borrower's perspective), brokerage fee, a unique identification code for the borrower, the date when the loan was initiated and its term, followed by a unique broker code. All the loan fees and brokerage fees are annualized.

We apply two different filters to the original data set. We select only relevant stocks and exclude the tickers favored by a tax arbitrage opportunity.

We define as relevant, the 100 largest[3] companies whose stocks were traded on the spot market at least once per day, during the 60-day window, 30 days before and 30 days after the launch of the benchmark. The tax arbitrage cited was an opportunity created by Brazilian law and described by Barbosa et al. (2018). Before August 2014, investors paid a tax of 15% to receive dividends, while financial institutions were exempt. This scenario

[2] BMF&Bovespa External Communication 013/2011-DN
[3] Measured by the market cap of 01/10/2010

encouraged abnormally high loan fees on days around the stock record date, in which individual investors lend stocks to financial institution who were not taxed on dividends. The arbitrage gain was then divided among the transaction participants. In order to deal with this problem, we remove all the tickers from companies which paid dividends during the 60-day interval of the database.

Our final sample has 101,671 loan contracts and 100 different stocks. Some descriptive statistics from our sample can be seen in Table 1. In it, it is possible to notice the great variance of loan fees among different tickers, with the maximum average loan fee being 16.09% and the minimum being 0.26% - considering the total sample. The brokerage fee values also show a great difference between the maximum value of 1.11% and the minimum of 0.05%. The number of deals, brokers and borrowers remain similar in the before and after samples. The loan fee, on the other hand, shows a fall in the period after the benchmark from 3.46% to 3.17%.

To calculate the ticker's characteristics used on the heterogeneous impact analysis, we use a data set similar to the one described above, however, in this case, the loan contracts information is daily aggregated. For each ticker and day, the data contain the average annualized loan fee, the interquartile range of loan fees and the sum of the number of borrowers. The information is available from October, 2010 to February, 2011. We compute, for each of the 100 tickers selected, the average value of: the loan fee, the interquartile range and the number of borrowers per day in these five months.

Finally, for the price efficiency analysis we use a database from the Bloomberg platform that comprises the closing and opening prices of each BMF&BOVESPA stock at a 15-minute interval. To calculate the high frequency price efficiency index (AR15) and the Pricing Error we use the information of the 100 tickers selected from January 31, 2011 to March 31, 2011. For the liquidity analysis we use a database from the Center for Research in Financial Economics of the University of São Paulo (NEFIN)[4], containing the Amihud Index and the turnover of the same 100 tickers from January 31, 2011 to March 31, 2011.

[4] For more information visit NEFIN's website

3 Empirical analysis

In this section we detail the methods used to analyze (1) the impacts of the new benchmark on the stock lending market, searching for evidence on loan and brokerage fees; (2) the relation between loan fees and stock price efficiency from a high frequency perspective; and the relation between loan fees and stock liquidity.

3.1 New benchmark effects on the stock lending market

To assess the effect of price transparency on the market, we searched for changes in the market conditions around the event date (March 1, 2011).

The first step of our analysis was to make all the key variables (loan fee and brokerage fee) from different tickers comparable. Therefore, we standardized them in terms of standard deviations, ensuring that all changes are measured according to the characteristics of each ticker. Next, we analyzed the impact of the new benchmark on brokerage and loan fee, comparing deals closed before and after the benchmark's launch.

Our empirical strategy, in order to provide evidence that the changes observed were caused by the introduction of the new benchmark, is based on a analysis of short-term effects. We explore the benchmark's impact using different time windows, starting with a period of 20 days - ten days before, and ten days after the introduction of the benchmark, followed by 40-day and 60-day windows. Through this approach we provide evidence of impacts that were caused by this exogenous transparency variation. The 20-day window has fewer observations and probably does not capture the whole effect, however its results are less likely to be impacted by unobserved events. The 60-day window has more observations and captures most of the short-term effect of the benchmark's launch, but is more susceptible to interference from other unobserved causes. The 40-day window is a compromise between the two.

For each of the cited time windows, we ran the following deal-level regression:

$$stdfee_{it} = \beta_0 + \beta_1 After_t + qty_{it} + t_t + \varepsilon_{it}$$

Where $stdfee_{it}$ is the standardized loan fee/brokerage fee value of each deal (i) on a given day (t), $After_t$ is a dummy variable flagging all the deals made after the introduction of the new benchmark, qty_{it} is the logarithm of the quantity of stocks borrowed in each deal and $t_t$is a control for time trends. After the initial results, we tested our OLS results including borrower and short-seller fixed effects. Next, we ran the same model for different

quantiles and inter-quantiles. The results of these regressions allow us to identify effects on different parts of the value distribution of brokerage and loan fees.

Further, we focus on the heterogeneity of the new benchmark impact on the loan fees of different types of tickers. To this, we run deal-level regressions with the interaction between the $After_t$ and ticker-level characteristics prior to the benchmark launch:

$$stdfee_{it} = \beta_0 + \beta_1 After_t + \beta_2 After_t \times Avgfee_j + t_t + \delta_j + \varepsilon_{it}$$

$$stdfee_{it} = \beta_0 + \beta_1 After_t + \beta_2 After_t \times BorrNum_j + t_t + \delta_j + \varepsilon_{it}$$

$$stdfee_{it} = \beta_0 + \beta_1 After_t + \beta_2 After_t \times Iqrrange_j + t_t + \delta_j + \varepsilon_{it}$$

All the ticker's unique characteristics were calculated from the loan contracts closed over the period of five months before the benchmark implementation, with $Avgfee_j$ being the average loan fee charged, $BorrNum_j$ the average number of borrowers per day, and $Iqrrange_j$ the average interquartile range of loan fees per day. The δ_j stands for the ticker (j) fixed effects.

3.2 Impact of short-selling on price efficiency and liquidity

In this part of the paper, we use the benchmark launch as an exogenous instrument for loan fees. This empirical strategy enable us to assess the effects of loan fees on stocks price efficiency and liquidity avoiding potential endogeneity. For each ticker and date, we build a data set that comprises the daily averages of the loan fees, the price efficiency indexes ($AR15$ and pricing error), and the liquidity measures (Amihud and turnover).

The $AR15$ is a measure of high-frequency price efficiency based on the Boehmer e Wu (2012) work, which uses the absolute value of quote midpoint return autocorrelations. The intuition presented by this paper, points out that if the midpoint value is the best estimation of market equilibrium value of the stock in any given time, then the returns should follow a random walk. Therefore, greater price efficiency should exhibit lower absolute autocorrelation values. We choose a 15-minute interval to calculate the (log) returns autocorrelation on a day, and use $AR15$ to denote the value obtained.

We compute the pricing error as suggested by Hasbrouck (1993). We use the Beveridge e Nelson (1981) decomposition process to decompose the 15-minute interval transaction price (p_t) into an efficient price component (m_t) (random walk) and a stationary component, the pricing error (s_t). The cyclic component (s_t) carries everything that deviates the stock price from its efficient component, that is why it is called "pricing

error". Because, by construction, the pricing error has zero-mean, its dispersion (σ_s) is a measure of its magnitude. Greater this value, more inefficient the price. In our analysis, the referred "pricing error" will be the dispersion σ_s standardized by the dispersion of intraday transaction prices (σ_p), being calculated as the ratio between both (σ_s/σ_p).

The measure of market liquidity will be made using the Amihud illiquidity index, calculated as the ratio between the return of the stock and the traded volume in a given day. The higher the index value, the more illiquid the stock. Alternatively, we use the logarithm of share turnover as another measure for liquidity. We obtain it dividing the number of shares traded and the total number of shares outstanding in the same period. In this case, the higher the value, the more liquid the stock.

Finally, we run a Panel IV regression for each one of the mentioned measures:

$$AR15_{jt} = \beta_0 + \beta_1 stdfee_{jt}(After_t) + \delta_j + \varepsilon_{jt}$$

$$pricingerror_{jt} = \beta_0 + \beta_1 stdfee_{jt}(After_t) + \delta_j + \varepsilon_{jt}$$

$$Amihud_{jt} = \beta_0 + \beta_1 stdfee_{jt}(After_t) + \delta_j + \varepsilon_{jt}$$

$$turnover_{jt} = \beta_0 + \beta_1 stdfee_{jt}(After_t) + \delta_j + \varepsilon_{jt}$$

Where the independent variables are the measures for price-efficiency and liquidity explained above, obtained for each ticker (j) on a day (t). The $stdfee_{jt}$ is the standardized average loan fee per day instrumented by the benchmark dummy variable ($After_t$). The δ_j stands for the ticker fixed effects.

4 Empirical results

This section is subdivided in three parts: (1) the loan fee analysis, (2) the brokerage fee analysis, and (3) the study of the relation between short-selling and the spot market (price efficiency and liquidity).

4.1 Loan fee

To explain how the loan fees were affected by the launch of the new benchmark, we first study its impacts on the average loan fee, followed by the same analysis but adding the investor- and broker-level fixed effects. Next, to understand this relation in more detail we look through the heterogeneous effects of the benchmark: (1) on the whole distribution of loan fees, using quantile and inter-quantile regressions, and (2) on the loan fees charged for different types of tickers.

4.1.1 Effect on the average loan fee

To search for evidence of impacts on the average loan fee, we built the graph displayed in Figure 1 which shows the daily average movements of the market. On it, each dot represents the market day average of equally-weighted standardized loan fees, which are negative for the days before the benchmark's launch and positive after it. We notice the substantial decrease in the loan fee amounts right after the introduction of the benchmark, represented by the red line on "Day 0".

To better understand the results, we applied the methodology described in the section 3. The results obtained using the 20-, 40-, and 60-day window OLS regressions are presented in Table 2.

The estimated coefficients show a negative effect on loan fees due to the benchmark's launch for all time windows analyzed. Additionally, we verify that using the 20-day time period, the impact is not completely captured, explaining the further increase in the intensity of the change in the second and third columns. The reduction of the 20-day windows of approximately 0.1 SD is significant at 11% and the 40/60-day windows of approximately 0.25 SD is significant at 1%. The coefficient of quantity of stocks per deals reports negative and significant values and these results are probably because the larger amounts of stocks traded could create an incentive for bargaining or possible discounts agreed upon by the transaction participants.

4.1.2 Investor- and broker-level fixed effects

The results obtained so far could be, in part, due to characteristics of the market players, such as skill and connections. To test this hypothesis we include in our model borrower and short-seller fixed effects, preventing us from seeing impacts from the differences between market players. The results of these tests are displayed in Table 3.

The coefficients previously estimated seem robust, and increase the significance of the 20-day estimations. The impact magnitude seen using the 40/60-day data shows even more similar results after the introduction of the new variables, and this, once again, suggests that the 40-day measurement already captures most of the effects caused by the benchmark introduction. The broker fixed-effect seems to capture the effect of quantity of deals, but the post-benchmark effect remains relevant and substantial, with the exception of the 20-day result. However, when we add the short-seller *and* the broker fixed-effects, all the post-benchmark coefficients show negative and significant impact. The 20-day result goes from -0.111 SD to -0.0985 SD; the 40-day result goes from -0.252 SD to -0.2 SD; and the 60-day result goes from -0.292 SD to -0.222 SD.

4.1.3 Heterogeneous effects: loan fee quantiles

In the previous analysis, we obtained results for the average of the standardized loan fee values. Now, we check the heterogeneity of the impact on different parts of the distribution of the fees. To do so, we ran quantile regressions for the lower standardized loan fees represented by the 0.1 and 0.25 quantiles of our data set, and ran quantile regressions for the higher standardized loan fees of the period, represented by the 0.75 and 0.9 quantiles. Finally, we verified the distribution impact by running inter-quantile regressions between these quantiles. The results are displayed in Table 4.

Moving on to the estimations, we noticed that the already low loan fees (in the 0.1 and 0.25 quantiles) decreased less than higher loan fees (those in the 0.75 and 0.9 quantiles). This suggests, as expected, that the presence of the new benchmark had a greater impact on transactions whose loan fees were above the market average. However, it is important to be aware that the benchmark's effect was not linear through the whole distribution, as the coefficient of the quantile 0.1 is higher than the one of the quantile 0.25. The negative estimations of the interquantile coefficients, displayed in the last two columns, corroborate the hypothesis that the benchmark squeezed the distribution of standardized loan fees, decreasing the higher fees more than the lower ones. Again, the difference between the analysis of the three time windows occurs only in the magnitude of the impacts observed, not on their direction. The values suggest that the measure of the effects is closer to the ones seen using 40 or 60 days, because both show similar values.

4.1.4 Heterogeneous effects: different types of tickers

In this part of the section, we search for heterogeneous impacts on the loan fee of different types of tickers. To do so, we create, for each ticker, three variables calculated from the loan deals made on this ticker during the period of five months before the new benchmark publication. The first is the average loan fee negotiated on all the deals, the second is the average number of borrowers per day, and the third is the average of the daily interquartile range of the loan fees. The idea behind these three measures is to better understand the impacts of the benchmark from three different perspectives.

The five-month average loan fee variable represents, via price, a higher or lower opacity level of the lending transactions of a specific ticker. The intuition behind this is that the stock lending activity is almost riskless from the lender perspective, so the loan fee should be closer to 0. However, a ticker with a history of higher loan fees suggest the presence of some level of opacity in its lending market. From this perspective, it is expected that the launch of a benchmark that increases the transparency of the market, should affect more tickers with a history of high loan fees. The results of the regressions on this variable are displayed in Table 5.

We run regressions for three time windows of 20, 40 and 60-day intervals around the benchmark launch date, containing the interaction between the "After benchmark" dummy and the average loan fee. All regressions include ticker fixed effects, trend control, and standard errors clustered at the ticker level. The estimations corroborate the expectation exposed above as the interaction coefficient estimations - that goes from -0.067 to -0.091 - suggest that tickers with history of higher average loan fees were more affected by the fall in loan fees due to the implementation of the new benchmark.

The average number of borrowers per day represents how common it is for market participants to negotiate the ticker. From this perspective, tickers with a higher number of borrowers can be considered well known by the lending market participants, and this knowledge includes information about loan fees usually charged. This scenario improves transparency, therefore we expect that a new benchmark will have less effect on those tickers, once their information is, on some level, easy to obtain. The results of the regressions on this variable are shown in Table 6.

We run regressions for three time windows of 20, 40 and 60-day intervals around the benchmark launch date, containing the interaction between the "After benchmark" dummy and the average daily number of borrowers. All regressions include ticker fixed effects, trend control, and standard errors clustered at the ticker level. The interaction coefficient positive estimations - that goes from 0.00329 to 0.00754 - suggest that tickers with history of higher number of borrowers were, indeed, less affected by the fall in loan fees due to the implementation of the new benchmark.

The average daily interquartile range of the loan fees measures the volatility of fees charged for each ticker. Greater interquartile range means that the loan fees vary within one day more than those of a ticker with a lower range. Once again, we run regressions for three time windows of 20, 40 and 60-day intervals around the benchmark launch date, containing the interaction between the "After benchmark" dummy and the average daily number of borrowers. All regressions include ticker fixed effects, trend control, and standard errors clustered at the ticker level. The estimations are displayed in Table 7.

Despite the non-significance at 10% level, the estimated negative coefficients of the interaction roughly suggest that tickers whose loan fees demonstrate more volatile behavior, represented by higher interquartile ranges, were more affected by the fall in loan fees due to the implementation of the new benchmark. This is logical because greater difference of loan fees charged for distinct borrowers is a indicative of higher opacity on ticker's lending operations, so we expected that the benchmark, as a transparency improvement, had greater impacts on these tickers. The results follow the same direction using intra-day loan fees standard deviations or range as alternative measures of volatility.

4.2 Effects on brokerage fees

In this subsection we analyze the impacts of the new benchmark implementation on the brokerage fees charged in each lending deal. To do so, we use the same methodology applied on the loan fees study, replacing the dependent variable "standardized loan fee" with the "standardized brokerage fee".

The results obtained were not significant when using the average brokerage fees approach. However, when we look to the impacts on upper and lower quantiles, we see that there are significant effects acting differently on the lower and the higher part of brokerage fee distribution. This suggests that for brokers with higher costs, i.e. that charge higher fees, fees decreased. On the other hand, low brokerage fees showed an increase, possibly related to the fact that low-cost brokers saw this as an opportunity to increase the fees by a small amount. The amounts can be seen in Table 8, which looks similar to Table 4, however, in this case, the variable of interest is the brokerage fee of the deals closed over the entire 60-day period.

4.3 Short-selling and characteristics of the spot market

In this subsection we change our study scope from the lending market to the spot market. We took into account the fact that the new benchmark is an exogenous event that had direct impact on loan fees, and use it as an instrument to assess the effects of loan fees on price efficiency and liquidity of the stock market. The idea is to understand

how short-selling constraints, represented by higher loan fees, impact the price efficiency and the liquidity of stocks in the spot market. This approach permit us to overcome the problem of endogeneity between the loan fees charged and the stock prices.

4.3.1 Price efficiency

As detailed in Section 3, we use two different price efficiency indexes in our empirical analysis. In the first, we use the absolute value of intraday return autocorrelation as suggested in Boehmer e Wu (2012), and in the second we calculate the pricing error as suggested in Hasbrouck (1993). These short-term price efficiency indexes (AR15 and pricing error) were daily computed using the quote midpoint return, considering an intraday 15-minutes interval. In both indexes, a higher value means lower price efficiency.

We run regressions for three different time windows of 20, 40 and 60-days around the benchmark implementation, first estimating the impact through Pooled OLS and after introducing the benchmark instrument on a Panel IV. The variables are indexed in ticker (j) and day (t) and all regressions included ticker fixed effects. The results of AR15 can be seen in Table 9. The positive, and significant, coefficient estimations suggest that higher loan fees, i.e. higher short-selling constraint, result in lower stock price-efficiency (higher AR15).

The results of the pricing error regressions can be seen in Table 10. The estimated coefficients are not statistic significant at 10% level, what makes difficult to get any conclusion besides the fact that they point in the same positive direction as the AR15 coefficients.

4.3.2 Stock liquidity

To investigate the impact of short-selling constraints in the spot market liquidity we also use two different measures, the Amihud illiquidity index and the (log) share turnover. We run regressions for three different time windows of 20, 40 and 60-days around the benchmark implementation, first estimating the impact through Pooled OLS and after introducing the benchmark instrument on a Panel IV. The variables are indexed in ticker (j) and day (t) and all regressions included ticker fixed effects.

The estimated coefficients of the two approaches can be seen in Table 12 and Table 11. The results obtained are inconclusive, because the positive estimations of the Amihud illiquidity index indicate that higher loans fees lead to higher illiquidiy. On the other hand, the turnover positive estimations suggest that greater loan fees lead to more liquidity. Both results have pros and cons, the turnover approach show estimations statistically significant at 1% level, but the trading volume[1] is a notoriously problematic proxy for liquidity

[1] In this short-term scenario, the turnover measure is almost the same as the trading volume, because

(BEBER; PAGANO, 2013). The Amihud results, in turn, are statistically significant at 10% level only in the 20 days window, which does not configure a very robust result for our purposes.

there is no relevant changing in the total number of shares outstanding.

5 Conclusion

Using a unique dataset of all the stock loan contracts from January 31, 2011 to March 31, 2011 containing 162,195 deals of 279 tickers, we examine (1) the impacts of a new benchmark publication and (2) whether short-selling constraints reduce price efficiency and/or liquidity. From (1), our study goes along with hypotheses drawn from Duffie, Dworczak e Zhu (2017) and shows that the new benchmark resulted in a decrease of the loan fees. From (2), we follow the hypothesis of Diamond e Verrecchia (1987) and the empirical method presented by Boehmer e Wu (2012), Hasbrouck (1993) and Beber e Pagano (2013). The results obtained point out to an association between higher short-selling constraints and lower price efficiency, and are inconclusive to the relation between short-selling and market liquidity.

The connection between both studies is due to the use of the new benchmark (1) as an instrument to measure the impact of loan fees on characteristics of the spot market (2). This approach is one of the main contributions of this article, because we were able to avoid, in our analysis, the endogeneity between the lending activity and the stock prices.

The impacts of the benchmark's publication on the loan fees is studied in detail in the first part of this paper. We found that the benchmark was responsible by a reduction in average loan fees, and a narrowing of loan and brokerage fee dispersion. We also find that the impact on loan fees was higher for tickers with a history of volatility, high average loan fee and low average number of borrowers per day.

After we show the relationship between the benchmark and the loan fees, we use this exogenous variation to assess the impacts of higher loan fees - a proxy for short-selling constraints - on the informational price efficiency and on the market liquidity. Our findings corroborate with the hypothesis that short-sellers trading contributes significantly to price discovery in equity markets, being short-selling associated with more efficient pricing. In other words, prices appear to be closer to efficient or fundamental values when short sellers are more active. The results for liquidity are inconclusive, as the analysis of the two different measures point out to opposite directions.

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Appendix

APPENDIX A – Figures and Tables

Figura 1 – Loan fee - market daily average

This figure shows the daily average movements of the market. Each dot represents the market day average of equally-weighted standardized loan fees, with days that are negative for the days before the benchmark, "0" on it, and positive after it.

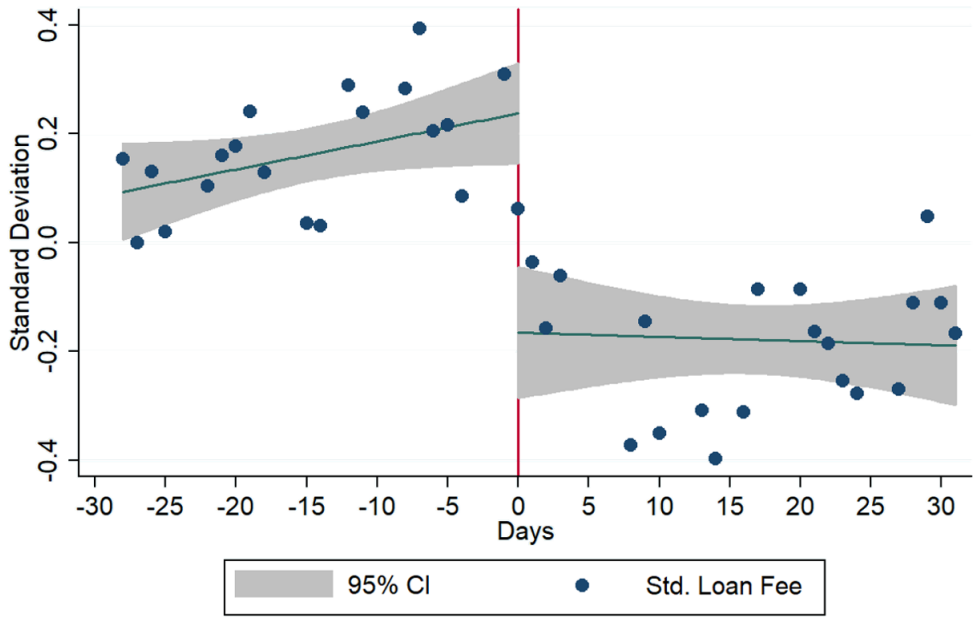

Tabela 1 – Sample Summary Statistics

This table shows descriptive statistics of our equity lending data set. Values correspondent to loan fees and brokerage fees are calculated as follows: i) we find the average loan/brokerage fee via tickers for the period, ii) we find the average/maximum/minimum of the values found on i).

	Full sample	Before	After
Number of deals	101,671	51,947	49,724
Loan fee average	3.33	3.46	3.17
Maximum loan fee	16.09	15.69	16.57
Minimum loan fee	0.26	0.2236	0.23
Average transaction volume by deal (USD)	132,138.4	116,195.2	151,220.7
Minimum transaction volume by deal (USD)	5,179.249	5,435.914	4,911.425
Maximum transaction volume by deal (USD)	1,107,594	775,022.8	1,848,460
Brokerage fee average	0.205284	0.1826	0.2202
Maximum brokerage fee	1.11	1.19	1.15
Minimum brokerage fee	0.0504	0.0125	0.043
Number of brokers	72	69	70
Number of borrowers	8,356	6,033	5,765

Tabela 2 – Benchmark impact on standardized loan fees

This table evaluates the impacts of the benchmark on loan fees. The estimated coefficients show a significant reduction of the loan fee average for the entire time windows analyzed. Additionally, we observe that 20-day period, the impact it is not completely captured, explaining the further increase in the intensity present in the second and third columns. The reduction for the 20-day windows of approximately 0.1 SD is significant at 11% and for the 40/60-day windows of approximately 0.25 SD is significant at 1%. The coefficient of quantity of stocks per deal reports negative and significant values, these results are probably because larger amounts of stocks traded could create incentive for bargain or possible discounts settled by the transaction participants.

	±10 days	±20 days	±30 days
After	-0.0992†	-0.240***	-0.285***
	(0.0608)	(0.0551)	(0.0608)
Qty of deals (log)	-0.0428***	-0.0351***	-0.0319***
	(0.00731)	(0.00764)	(0.00811)
Trend	-0.0251***	-0.00294	0.00201
	(0.00776)	(0.00407)	(0.00424)
Constant	0.537***	0.413***	0.340***
	(0.0559)	(0.0782)	(0.109)
Observations	34,546	65,201	101,671
R-squared	0.026	0.024	0.019

Robust standard errors in parentheses
OLS clustered by ticker
*** p<0.01, ** p<0.05, † p<0.15

Tabela 3 – Benchmark impact on standardized loan fees (fixed effects)

This table evaluates the results of OLS regressions with borrower and short-seller fixed effects. The coefficients estimated are statistically significant for all the time windows represented by the Panel A, B, and C. The impact magnitude seen using the 40/60-day periods shows even more similar results after the introduction of the new variables, which suggests that the 40-day period already captures most of the effects caused by the benchmark's launch. When we add the short-seller *and* the broker fixed-effects all the post-benchmark coefficients show negative and significant impact. The 20-day results go from -0.111 SD to -0.0985 SD; the 40-day result from -0.252 SD to -0.2 SD; and the 60 day-result from -0.292 SD to -0.222 SD.

	(1)	(2)	(3)	(4)	(5)
			Panel A: ±10 days		
After	-0.111*	-0.0992	-0.108**	-0.0661	-0.0985**
	(0.0622)	(0.0608)	(0.0524)	(0.0553)	(0.0486)
Qty of deals (log)		-0.0428***	0.00938	-0.00794	0.0108
		(0.00731)	(0.00761)	(0.00602)	(0.00672)
Trend	-0.0245***	-0.0251***	-0.0206***	-0.0276***	-0.0232***
	(0.00797)	(0.00776)	(0.00629)	(0.00729)	(0.00640)
Constant	0.218***	0.537***	0.120*	0.274***	0.0884
	(0.0465)	(0.0559)	(0.0629)	(0.0531)	(0.0611)
Observations	34,546	34,546	34,546	34,546	31,926
R-squared	0.018	0.026	0.420	0.120	0.336
			Panel B: ±20 days		
After	-0.252***	-0.240***	-0.200***	-0.211***	-0.200***
	(0.0544)	(0.0551)	(0.0494)	(0.0529)	(0.0466)
Qty of deals (log)		-0.0351***	0.0153**	-0.00393	0.0159**
		(0.00764)	(0.00651)	(0.00613)	(0.00615)
Trend	-0.00215	-0.00294	-0.00434	-0.00420	-0.00476
	(0.00405)	(0.00407)	(0.00405)	(0.00432)	(0.00379)
Constant	0.143***	0.413***	0.0310	0.179**	0.00868
	(0.0509)	(0.0782)	(0.0743)	(0.0692)	(0.0718)
Observations	65,201	65,201	65,201	65,201	62,004
R-squared	0.019	0.024	0.368	0.103	0.301
			Panel C: ±30 days		
After	-0.292***	-0.285***	-0.222***	-0.253***	-0.222***
	(0.0600)	(0.0608)	(0.0501)	(0.0547)	(0.0478)
Qty of deals (log)		-0.0319***	0.0143**	-0.00165	0.0154**
		(0.00811)	(0.00604)	(0.00627)	(0.00587)
Trend	0.00242	0.00201	-0.00175	0.000392	-0.00194
	(0.00421)	(0.00424)	(0.00421)	(0.00432)	(0.00406)
Constant	0.0944	0.340***	0.0360	0.129	0.0188
	(0.0806)	(0.109)	(0.0995)	(0.102)	(0.0980)
Observations	101,671	101,671	101,671	101,671	98,463
R-squared	0.015	0.019	0.299	0.097	0.266
Short Seller FE	No	No	Yes	No	Yes
Broker FE	No	No	No	Yes	Yes

Robust standard errors in parentheses
OLS clustered by ticker
*** p<0.01, ** p<0.05, * p<0.1

Tabela 4 – Benchmark impact on standardized loan fees (quantiles and inter-quantiles)

This table shows the results of quantile regressions for the lower standardized loan fees represented by the 0.1 and 0.25 quantiles of our data set, and quantile regressions for the higher standardized loan fees of the period, represented by the 0.75 and 0.9 quantiles. Additionally, it shows the impact on distribution represented by the inter-quantile regressions between these quantiles. With the results, we observe that the already low loan fees (in the 0.1 and 0.25 quantiles) decreased less than higher loan fees (0.75 and 0.9 quantiles). This suggests that the presence of the new benchmark had a greater impact on transactions whose loan fees were above the market average. The negative estimations of the interquantile coefficients, displayed in the last two columns, corroborates the hypothesis that the benchmark squeezed the distribution of standardized loan fees, decreasing the higher fees more than the lower one.

	OLS	$Q_{(0.1)}$	$Q_{(0.25)}$	$Q_{(0.75)}$	$Q_{(0.9)}$	$IQ_{(0.75-0.25)}$	$IQ_{(0.9-0.1)}$
				Panel A: ±10 days			
After	-0.0992	-0.146***	-0.0401***	-0.186***	-0.300***	-0.146***	-0.154**
	(0.0608)	(0.0163)	(0.00775)	(0.0219)	(0.0637)	(0.0176)	(0.0601)
Qty of deals (log)	-0.0428***	-0.00117	-0.0103***	-0.0458***	-0.134***	-0.0355***	-0.133***
	(0.00731)	(0.00134)	(0.000865)	(0.00195)	(0.00717)	(0.00275)	(0.00649)
Trend	-0.0251***	-0.0161***	-0.00927***	-0.0275***	-0.0452***	-0.0182***	-0.0291***
	(0.00776)	(0.00210)	(0.00114)	(0.00299)	(0.00949)	(0.00266)	(0.00917)
Constant	0.537***	-0.456***	-0.259***	0.792***	2.395***	1.051***	2.851***
	(0.0559)	(0.0126)	(0.00787)	(0.0208)	(0.0734)	(0.0295)	(0.0604)
Observations	34,546	34,546	34,546	34,546	34,546	34,546	34,546
R-squared	0.026						
				Panel B: ±20 days			
After	-0.240***	-0.246***	-0.0735***	-0.259***	-0.513***	-0.185***	-0.268***
	(0.0551)	(0.0169)	(0.00524)	(0.0150)	(0.0382)	(0.0180)	(0.0524)
Qty of deals (log)	-0.0351***	0	-0.00636***	-0.0402***	-0.109***	-0.0339***	-0.109***
	(0.00764)	(0.00208)	(0.000648)	(0.00166)	(0.00328)	(0.00144)	(0.00592)
Trend	-0.00294	-0.00309**	-0.00221***	-0.0123***	-0.00234	-0.0101***	0.000744
	(0.00407)	(0.00120)	(0.000385)	(0.00108)	(0.00285)	(0.00127)	(0.00388)
Constant	0.413***	-0.499***	-0.287***	0.753***	1.950***	1.040***	2.449***
	(0.0782)	(0.0194)	(0.00606)	(0.0173)	(0.0398)	(0.0161)	(0.0461)
Observations	65,201	65,201	65,201	65,201	65,201	65,201	65,201
R-squared	0.024						
				Panel C: ±30 days			
After	-0.285***	-0.218***	-0.0825***	-0.399***	-0.571***	-0.317***	-0.352***
	(0.0608)	(0.00940)	(0.00505)	(0.0127)	(0.0341)	(0.00870)	(0.0271)
Qty of deals (log)	-0.0319***	5.11e-05	-0.00586***	-0.0392***	-0.0942***	-0.0333***	-0.0943***
	(0.00811)	(0.00103)	(0.000578)	(0.00152)	(0.00396)	(0.00171)	(0.00372)
Trend	0.00201	-0.00405***	-0.00240***	-0.00184***	0.00910***	0.000560	0.0131***
	(0.00424)	(0.000391)	(0.000207)	(0.000551)	(0.00150)	(0.000555)	(0.00103)
Constant	0.340***	-0.515***	-0.299***	0.744***	1.745***	1.044***	2.260***
	(0.109)	(0.0101)	(0.00512)	(0.0149)	(0.0377)	(0.0182)	(0.0354)
Observations	101,671	101,671	101,671	101,671	101,671	101,671	101,671
R-squared	0.019						

Robust standard errors in parentheses
OLS clustered by ticker
*** p<0.01, ** p<0.05, * p<0.1

Tabela 5 – Benchmark heterogeneous impact on standardized loan fees (average loan fee by ticker)

This table shows the heterogeneous impact of the benchmark on the standardized loan fees of different types of tickers. In this estimation we calculate the average loan fee charged from October, 2010 until February, 2011 for each ticker present in our database. We run regressions for three time windows of 20, 40 and 60 days interval around the benchmark launch date, containing the interaction between the "After benchmark" dummy and the average loan fee obtained as explained. All regressions include ticker fixed effects, trend control, and standard errors clustered at the ticker level. The interaction coefficient estimations - that goes from -0.067 to -0.091 - suggest that tickers with history of higher average loan fees were more affected by the fall in loan fees due to the implementation of the new benchmark.

	±10 days	±20 days	±30 days
After	0.0693	-0.0858	-0.0495
	(0.0934)	(0.0882)	(0.0976)
After * Avg. loan fee	-0.0729***	-0.0670**	-0.0910***
	(0.0250)	(0.0260)	(0.0283)
Constant	0.228***	0.147***	0.0982
	(0.0430)	(0.0482)	(0.0764)
Observations	34,546	65,201	101,671
R-squared	0.025	0.025	0.026
Ticker FE	Yes	Yes	Yes
Trend	Yes	Yes	Yes

Robust standard errors in parentheses
OLS clustered by ticker
*** p<0.01, ** p<0.05, * p<0.1

Tabela 6 – Benchmark heterogeneous impact on standardized loan fees (average daily number of borrowers by ticker)

This table shows the heterogeneous impact of the benchmark on the standardized loan fees of different types of tickers. In this estimation we calculate the average daily number of borrowers from October, 2010 until February, 2011 for each ticker present in our database. We run regressions for three time windows of 20, 40 and 60 days interval around the benchmark launch date, containing the interaction between the "After benchmark" dummy and the average daily number of borrowers. All regressions include ticker fixed effects, trend control, and standard errors clustered at the ticker level. The interaction coefficient positive estimations - that goes from 0.00329 to 0.00754 - suggest that tickers with history of higher number of borrowers were less affected by the fall in loan fees due to the implementation of the new benchmark.

	±10 days	±20 days	±30 days
After	-0.232**	-0.368***	-0.515***
	(0.0904)	(0.0807)	(0.146)
After * Avg. daily number of borrowers	0.00334***	0.00329***	0.00754**
	(0.00107)	(0.00120)	(0.00330)
Constant	0.221***	0.146***	0.0964
	(0.0449)	(0.0502)	(0.0758)
Observations	34,640	65,201	101,671
R-squared	0.020	0.021	0.021
Ticker FE	Yes	Yes	Yes
Trend	Yes	Yes	Yes

Robust standard errors in parentheses
OLS clustered by ticker
*** p<0.01, ** p<0.05, * p<0.1

Tabela 7 – Benchmark heterogeneous impact on standardized loan fees (average daily interquartile range of loan fees by ticker)

This table shows the heterogeneous impact of the benchmark on the standardized loan fees of different types of tickers. In this estimation we calculate the average daily interquartile range of loan fees from October, 2010 until February, 2011 for each ticker present in our database. We run regressions for three time windows of 20, 40 and 60 days interval around the benchmark launch date, containing the interaction between the "After benchmark" dummy and the average daily interquartile range of loan fees. All regressions include ticker fixed effects and trend control, standard errors are clustered at the ticker level. In this scenario the interaction coefficient estimations were not significant at 10% level, however the results roughly suggest that tickers whose loan fees demonstrate more volatile behavior, represented by higher interquartile ranges, were more affected by the fall in loan fees due to the implementation of the new benchmark.

	±10 days	±20 days	±30 days
After	-0.0456	-0.193**	-0.201**
	(0.101)	(0.0851)	(0.0866)
After * Avg. iqr range	-0.0984	-0.0916	-0.130†
	(0.105)	(0.0856)	(0.0805)
Constant	0.226***	0.146***	0.0971
	(0.0470)	(0.0510)	(0.0809)
Observations	34,546	65,201	101,671
R-squared	0.020	0.021	0.018
Ticker FE	Yes	Yes	Yes
Trend	Yes	Yes	Yes

Robust standard errors in parentheses
OLS clustered by ticker
*** p<0.01, ** p<0.05, † p<0.15

Tabela 8 – Benchmark impact on standardized brokerage fees (quantiles and inter-quantiles)

This table shows the results of quantile regressions for the lower standardized brokerage fees represented by the 0.1 and 0.25 quantiles of our data set, and quantile regressions for the higher standardized brokerage fees of the period, represented by the 0.75 and 0.9 quantiles. Additionally, it shows the impact on the distribution represented by the inter-quantile regressions between these quantiles. With the results, we observe that the low brokerage fees (in the 0.1 and 0.25 quantiles) increased a bit (by aprox. 0.01 SD). On the other hand, the higher brokerage fees (0.75 and 0.9 quantiles) decreased aprox. -0.1 SD. This suggests that for brokers with higher costs, i.e. that charge higher fees, fees decreased.

	OLS	$Q_{(0.1)}$	$Q_{(0.25)}$	$Q_{(0.75)}$	$Q_{(0.9)}$	$IQ_{(0.75-0.25)}$	$IQ_{(0.9-0.1)}$
				Panel A: ±10 days			
After	-0.0389	0.0104**	-0.00290	-0.0891***	-0.0451	-0.0862***	-0.0555
	(0.0547)	(0.00408)	(0.00678)	(0.0221)	(0.0561)	(0.0188)	(0.0395)
Qty of deals (log)	-0.0389***	0.000701*	0.00423***	-0.0727***	-0.163***	-0.0769***	-0.163***
	(0.00906)	(0.000403)	(0.000790)	(0.00225)	(0.00585)	(0.00246)	(0.00709)
Trend	0.00462	-4.14e-05	0.000703	0.00906***	-0.0142*	0.00835***	-0.0141*
	(0.00865)	(0.000544)	(0.00102)	(0.00321)	(0.00826)	(0.00323)	(0.00800)
Constant	0.282***	-0.581***	-0.485***	0.608***	2.130***	1.092***	2.711***
	(0.0867)	(0.00486)	(0.00749)	(0.0259)	(0.0627)	(0.0249)	(0.0779)
Observations	34,638	34,638	34,638	34,638	34,638	34,638	34,638
R-squared	0.000						
				Panel B: ±20 days			
After	-0.0317	0.00126	-0.00720***	-0.0909***	-0.210***	-0.0837***	-0.212***
	(0.0455)	(0.00201)	(0.00193)	(0.0147)	(0.0416)	(0.0119)	(0.0317)
Qty of deals (log)	-0.0446***	-0	0.00173***	-0.0813***	-0.168***	-0.0830***	-0.168***
	(0.00744)	(6.66e-05)	(0.000224)	(0.00154)	(0.00500)	(0.00174)	(0.00271)
Trend	0.00282	-0	0.00107***	0.00590***	0.0120***	0.00484***	0.0120***
	(0.00292)	(3.96e-05)	(0.000142)	(0.00110)	(0.00307)	(0.000896)	(0.00279)
Constant	0.317***	-0.594***	-0.465***	0.679***	1.999***	1.144***	2.593***
	(0.0604)	(0.000631)	(0.00274)	(0.0179)	(0.0509)	(0.0189)	(0.0390)
Observations	65,201	65,201	65,201	65,201	65,201	65,201	65,201
R-squared	0.000						
				Panel C: ±30 days			
After	-0.0657	0.0157***	-0.000298	-0.108***	-0.268***	-0.108***	-0.283***
	(0.0436)	(0.00410)	(0.00186)	(0.0123)	(0.0294)	(0.0131)	(0.0286)
Qty of deals (log)	-0.0507***	0.00359***	0.00371***	-0.0850***	-0.173***	-0.0887***	-0.177***
	(0.00650)	(0.000482)	(0.000180)	(0.00127)	(0.00341)	(0.00137)	(0.00248)
Trend	0.00591***	0.000165	0.000583***	0.00662***	0.0167***	0.00604***	0.0165***
	(0.00187)	(0.000171)	(7.75e-05)	(0.000531)	(0.00128)	(0.000595)	(0.00113)
Constant	0.296***	-0.561***	-0.491***	0.672***	1.886***	1.163***	2.446***
	(0.0530)	(0.00453)	(0.00200)	(0.0139)	(0.0339)	(0.0177)	(0.0288)
Observations	101,671	101,671	101,671	101,671	101,671	101,671	101,671
R-squared	0.013						

Robust standard errors in parentheses
OLS clustered by ticker
*** p<0.01, ** p<0.05, * p<0.1

Tabela 9 – Impacts of short-selling (loan fees) on stock's price efficiency (AR15): benchmark as an instrument

This table shows the relation between short-selling (via loan fees) and the stock's price efficiency. We use the absolute value of intraday return autocorrelation as a measure for price efficiency as suggested in Boehmer e Wu (2012). This short-term price efficiency index (AR15) was daily computed by the absolute value of quote midpoint return autocorrelation, considering an intraday 15 minutes interval. In the AR15, a higher value means low price efficiency. To overcome the problem of endogeneity between the loan fee charged and the stock price efficiency we use an exogenous event as an instrument: the launch of the benchmark. We run regressions for three different time windows of 20, 40 and 60-days around the benchmark implementation, first estimating the impact through Pooled OLS and after introducing the benchmark instrument on a Panel IV. The variables are indexed in ticker (j) and day (t) and all regressions included ticker fixed effects. The positive coefficient estimations suggest that higher loan fees, i.e. higher short-selling constraint, result in lower stock price-efficiency (higher AR15).

	±10 days		±20 days		±30 days	
	POLS	Panel IV	POLS	Panel IV	POLS	Panel IV
Std. Loan fee	-0.00282	0.0460*	-0.00246	0.0423**	0.00117	0.0372*
	(0.00567)	(0.0251)	(0.00364)	(0.0178)	(0.00260)	(0.0212)
Constant	0.272***	0.272***	0.268***	0.268***	0.267***	0.267***
	(1.92e-10)	(8.33e-10)	(1.11e-10)	(5.84e-10)	(1.09e-10)	(9.23e-10)
Observations	882	882	1,755	1,755	2,902	2,902
R-squared	0.000		0.000		0.000	
Ticker FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tabela 10 – Impacts of short-selling (loan fees) on stock's price efficiency (pricing error): benchmark as an instrument

This table shows the relation between short-selling (via loan fees) and the stock's price efficiency. We use pricing error to measure price efficiency as suggested in Hasbrouck (1993). This short-term price efficiency index was daily computed by the standard deviation of the pricing error standardized by the dispersion of the transaction prices, considering an intraday 15 minutes interval. In the pricing error index, a higher value means low price efficiency. To overcome the problem of endogeneity between the loan fee charged and the stock price efficiency we use an exogenous event as an instrument: the launch of the benchmark. We run regressions for three different time windows of 20, 40 and 60-days around the benchmark implementation, first estimating the impact through Pooled OLS and after introducing the benchmark instrument on a Panel IV. The variables are indexed in ticker (j) and day (t) and all regressions included ticker fixed effects. The non-significant positive coefficient estimations roughly suggest that higher loan fees, i.e. higher short-selling constraint, result in lower stock price-efficiency.

	±10 days		±20 days		±30 days	
	POLS	Panel IV	POLS	Panel IV	POLS	Panel IV
Std. Loan fee	-0.0357**	0.0622	-0.0108	0.042	0.000506	0.0531
	(0.0145)	(0.0653)	(0.00987)	(0.0467)	(0.00679)	(0.05)
Constant	0.346***		0.327		0.329***	
	(-1.22e-10)				(1.27e-10)	
Observations	773	773	1,572	1,572	2,600	2,600
R-squared	0.009		0.001		0.000	
Ticker FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tabela 11 – Impacts of short-selling (loan fees) on stock's liquidity (turnover): benchmark as an instrument

This table shows the relation between short-selling (via loan fees) and the stock's liquidity in the spot market. We use the turnover as a measure for liquidity. This index was computed by day and ticker, being the ratio between the number of shares traded and the total number of shares outstanding in the same period. The higher the turnover number, the more liquid the market. To overcome the problem of endogeneity between the loan fee charged and the stock prices we use an exogenous event as an instrument: the launch of the benchmark. We run regressions for three different time windows of 20, 40 and 60-days around the benchmark implementation, first estimating the impact through Pooled OLS and after introducing the benchmark instrument on a Panel IV. The variables are indexed in ticker (i) and day (t) and all regressions included ticker fixed effects. The positive coefficient estimations suggest that higher loan fees, i.e. higher short-selling constraint, result in more market liquidity.

	±10 days		±20 days		±30 days	
	POLS	Panel IV	POLS	Panel IV	POLS	Panel IV
Std. Loan fee	-0.00488	0.193***	0.00124	0.169***	0.0208*	0.296***
	(0.0188)	(0.0711)	(0.0145)	(0.0550)	(0.0118)	(0.0654)
Constant	-6.367***		-6.337***		-6.334***	
	(5.89e-10)		(3.89e-10)		(3.55e-10)	
Observations	1,078	1,078	2,132	2,132	3,518	3,518
R-squared	0.000		0.000		0.000	
Ticker FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Tabela 12 – Impacts of short-selling (loan fees) on spot market liquidity (Amihud illiquidity measure): benchmark as an instrument

This table shows the relation between short-selling (via loan fees) and the stock's liquidity in the spot market. We use the Amihud illiquidity index as a measure for liquidity. This index was computed by day and ticker, being the ratio between the return of the stock and the traded volume. The higher the Amihud index number, the more illiquid the market. To overcome the problem of endogeneity between the loan fee charged and the stock prices we use an exogenous event as an instrument: the launch of the benchmark. We run regressions for three different time windows of 20, 40 and 60-days around the benchmark implementation, first estimating the impact through Pooled OLS and after introducing the benchmark instrument on a Panel IV. The variables are indexed in ticker (i) and day (t) and all regressions included ticker fixed effects. The positive coefficient estimations suggest that higher loan fees, i.e. higher short-selling constraint, result in lower market liquidity.

	±10 days		±20 days		±30 days	
	POLS	Panel IV	POLS	Panel IV	POLS	Panel IV
Std. Loan fee	0.0269	0.174*	-0.00728	0.111	-0.0121	0.0817
	(0.0228)	(0.0933)	(0.0164)	(0.0817)	(0.00810)	(0.0923)
Constant	0.292***		0.268***		0.274***	
	(9.23e-10)		(3.84e-10)		(2.37e-10)	
Observations	1,095	1,095	2,170	2,170	3,583	3,583
R-squared	0.001		0.000		0.000	
Ticker FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Annex

ANNEX A – Public Notice

Figura 2 – BMF&Bovespa External Communication

Message from the BMF&Bovespa notifying changes in the way the loan fee information is published.

BM&FBOVESPA
A Nova Bolsa

February 23, 2011
013/2011-DN

EXTERNAL COMMUNICATION

To: The BM&FBOVESPA (BVMF) Market Participants – Bovespa Segment

Re: **Changes to the Publication of Fees on Registered Loans at the Securities Lending Service (BTC).**

We hereby inform you that as of **March 1, 2011**, the average fees on registered loans at the BTC will be published on the internet based on a **3 (three) business day period** per security. At present the published period is for 15 (fifteen) business days.

We highlight that the purpose of this change is to make the securities lending service ever more transparent, in order to attract more securities lenders and borrowers and to meet the demand of institutional investors.

For further information about securities lending please click on www.cblc.com.br/cblc/ingles > Securities Lending Program > Consult > Registered Loan.

José Antonio Gragnani
Chief Business Development Officer

BM&FBOVESPA S.A. – Bolsa de Valores, Mercadorias e Futuros
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Este material foi impresso em papel certificado FSC.
Florestas Globais Selo de Qualidade FSC

ANNEX B – Benchmark data legend

Figura 3 – BMF&Bovespa - Benchmark document layout

Document published in 2008 showing how the benchmark information was released. The document was still valid current March 1, 2011, however, on that date, the period mentioned in the "Register 01" section changed from 15 business days to 3.

CBLC
Companhia Brasileira de Liquidação e Custódia

FILE OF REGISTERED LOANS/TOTAL BANCO DE TITULOS - BTC	Use: External	Page: 2/2
Capítulo: File of Registered Loans/Total – DBTCER9999	Version: 02	Date: 30/06/2008

3.2 – REGISTER – 01 – REGISTERED POSITION IDENTIFICATION

FIELD DESCRIPTION	CONTENT	TYPE AND SIZE	INITIAL POSITION	FINAL POSITION
01 – REGISTRATION TYPE	FIXED "01"	N(02)	01	02
02 – STOCK ID	PAPER NEGOTIATION ID	X(20)	03	22
03 - COMPANY	COMPANY NAME ABREV.	X(30)	23	52
04 – NUMBER OF DEALS	QUANTITY OF LOAN CONTRACTS REGISTERED IN THE PERIOD	N(10)	53	62
05 – NUMBER OF STOCKS	QUANTITY OF STOCKS INVOLVED IN LOAN CONTRACTS REGISTERED IN THE PERIOD	N(11)	63	73
06 – VALUE (R$)	SUM OF VALUE (R$) OF ALL DEALS REGISTERED IN THE PERIOD	N(18)V2	74	93
07 – AVERAGE LOAN FEE - LENDER	AVERAGE LOAN FEE PRACTICED BY LENDERS IN THE CONTRACTS REGISTERED IN THE PERIOD	N(05)V2	94	100
08 – AVERAGE LOAN FEE - BORROWER	AVERAGE LOAN FEE PRACTICED BY BORROWERS IN THE CONTRACTS REGISTERED IN THE PERIOD	N(05)V2	101	107
09 – RESERVE	BLANK	X(53)	108	160