Price-Volume Relationship in the Brazilian Market, Stock Lending and Technical Analysis

(Relação entre Preço e Volume de Negócios, Empréstimo de Ações e Análise Técnica)

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Abstract

The paper tests the relevance of contemporaneous trading volume information for the pricing of shares of stock in the Brazilian market. As developed by Karpoff (1987), the particular relationship results from positive covariance between a stock's market turnover and the absolute value of that stock's price change in the same period. In Technical Analysis, it is believed that a role exists for trading information when predicting or at least explaining market price changes. The results show that the predicted V-shaped relationship is significant, so that the technical analysis argument is at least partially vindicated, and also contradicts the efficient market hypothesis, since this hypothesis says that all relevant information would already be reflected in current market prices. The paper uses daily data for 47 individual stocks traded at the BM&FBovespa over the period from January 04, 2010 to June 28, 2013, and tests the proposed hypothesis using ordinary least squares and estimation of panel data with fixed effects for both stock and day.

Keywords: market efficiency, technical analysis; price-volume relationship.

JEL codes: G11, G12, G14.

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Resumo

O trabalho testa a relevância de informações contemporâneas de volume de negócios na formação de preços de ações no mercado brasileiro. Tal como desenvolvida por Karpoff (1987), a relação específica resulta de covariância positiva entre o giro dos negócios e o módulo da variação do preço de uma ação no mesmo período. Em Análise Técnica, acredita-se haver um papel a ser desempenhado pela quantidade negociada ao se predizer ou pelo menos explicar variações de preço de mercado. Os resultados mostram que a relação prevista, em forma de V, é significante, de modo que o argumento da análise técnica é ao menos parcialmente validado, e também contradiz a hipótese de mercado eficiente, pois esta diz que toda informação relevante já estaria refletida nos preços correntes de mercado. O trabalho utiliza dados diários de 47 ações individuais negociadas na BM&FBovespa cobrindo o período de 04 de janeiro de 2010 a 28 de junho de 2013 e testa a hipótese proposta usando mínimos quadrados ordinários e estimação com dados em painel, com efeitos fixos de ação e dia.

Palavras-chave: eficiência de mercado; análise técnica; relação preço-volume de negócios.

1. Introduction

According to Blume et al. (1994), technical analysts believe that both price and volume data signal future price movements. Hence, the examination of *both* price *and* volume data would be useful to improving knowledge of return fundamentals. "If markets are efficient in the sense that the current price impounds all information, then such activity [technical analysis] is clearly pointless. But if the process by which prices adjust to information is not immediate, then market statistics [such as trading volume] may impound information that is not yet incorporated into the current market price. In particular, volume may be informative about the process of security returns." (BLUME et al., 1994, p. 153)

The present paper examines the relationship between price and volume series in the Brazilian stock market, by first testing the so-called "V-shaped relationship" theoretically developed by Karpoff (1987) and identified in several empirical papers for the U.S. market.[1] That relationship is expressed by the existence of a positive covariance

[1] Karpoff (1987) surveyed the existing empirical literature available at the time for the U.S. equity and commodity, currency and T-bill futures markets. A total of 18 papers had been published by then, and 17 of the papers surveyed had found evidence for the correlation between trading volume and the absolute value of price changes, as examined in this paper. Additional, more recent results are described in section II of the paper.

between volume statistics, usually measured by turnover – that is, the ratio between, say, daily financial trading volume and the total market value of a firm's equity – and the absolute value of that equity's price change in the same period. That evidence clearly contradicts the implication from market efficiency: current price would not impound all information.

The paper also considers additional information that may be provided by activity in the Brazilian stock lending market, as a determinant of trading activity in the spot stock market. Borrowers of stocks use this market for two main purposes: (a) getting hold of securities to be delivered as a result of previous borrowings; (b) short selling in order to benefit from stock price declines, in isolation or as part of long-short, arbitrage strategies.

A previous study for the Brazilian market was Saatcioglu and Starks (1998), but it used a stock market index instead of individual stocks, as is done here, allowing us to associate the intensity of the V-shaped volume-price change relationship with certain security characteristics. Stocks of forty-seven different issuing companies are examined in this paper. Another important difference is their use of monthly data, instead of daily data, and for a period that pre-existed the operation of the stock lending market in Brazil.

Hence, this paper also adds to the international literature by assessing the impact of the lending market segment on the strength of the V-shaped relationship between spot market trading activity and spot market price changes, and is also one of the first papers on the Brazilian market to make use of lending market data.

The remainder of this paper is structured as follows: section II reviews the relevant literature, from Karpoff (1987) on, and including papers that consider a role for securities lending in the determination of equity market prices. Section III presents the main hypotheses being tested, while section IV provides details on the variables and the sources of data used. Section V then explains the methodology used for hypothesis testing, section VI provides the results and section VII concludes.

2. Review of literature

2.1. The relevance of market volume in technical analysis

Users of tools of technical analysis in the development of trading strategies contend that volume or a similar market trading statistic supports the inferences drawn from price behavior: "The odds increase that a technical signal is correct if there is confirmation from another unrelated indicator. In the days when only chart patterns were available as a means of interpreting price action, the technical analyst uses volume as the confirming indicator." (KIRKPATRICK & DAHLQUIST, 2007, p. 411)

The same authors also refer to a much older technical analysis handbook (GARTLEY, 1935), in which the following general rules were enunciated for how to interpret a change in volume (among others): (1) when prices are rising, volume increasing is impressive, but volume decreasing is questionable; (2) when prices are declining, volume increase is impressive, but volume decreasing is questionable. Hence, price changes would have to be "confirmed" by volume. In addition, "when a price advance halts with high volume, it is potentially a top [but] when a price decline halts with high volume, it is potentially a bottom." (KIRKPATRICK & DAHLQUIST, 2007, P. 416.

As explained in Bodie et al. (2014), if prices respond slowly enough to new, fundamental information, the price adjustment period would be take the form of a sluggish response of prices to fundamental supply-and-demand factors (p. 354-355). Therefore, price changes could be attributed to changes in the volume of trading, i.e., the current information on quantities bought and sold.

As further support for the potential information content of volume data, a well-known technical analysis manual, when summarizing so-called "tactical methods", recommends, among other procedures, to get out of present commitments on "one-day reversal if marked by heavy volume" (EDWARDS & MAGEE, 1998, p. 507), or to make new commitments "on Flags and Pennants, after sufficient Secondary or Corrective Move by the pattern, or (possibly) within the pattern, provided that volume and all other indications tend strongly to confirm the pattern." (EDWARDS & MAGEE, 1998, p. 508)

Hence, it seems clear that technical analysis is predicated on a belief in the existence of some information content in volume statistics. In the next two sections, an appeal to modern finance theory arguments and models is made to provide additional support to that belief.

2.2. On the volume-price change relationship without a limited role for stock borrowing and lending

In a survey of the then existing literature, both theoretical and empirical, Karpoff (1987) developed explanations for the observed relationships of stock market turnover with both the magnitude (i.e., the absolute value) of contemporaneous returns, and also with signed returns.

In addition to his own specific modeling in that paper, the author appealed to two well-known market adages:[2]

(a) Volume is high in bullish markets, low in bearish markets; this would be consistent with positive covariance between volume (turnover) and signed returns, represented by Δp.

(b) It takes volume to change prices, in any direction; this would be consistent, if true, with positive covariance between volume (turnover) and the magnitude of returns, represented by the absolute value of Δp, or $|\Delta p|$.

The argument had to do with the association of volume and price with information flows in a sequential information arrival process, where information dissemination is gradual.

In Copeland's (1976) basic model, information is disseminated one trader at a time. With N traders, suppose k are optimists, r are pessimists, and $N - k - r$ are uninformed investors, at any time before all N investors become informed. Short sales are assumed to be prohibited.[3] Therefore, the trading activity generated by a pessimist is usually lower than that generated by an optimistic investor. Hence, price change and trading volume when the next trader becomes informed depend on (a) the preceding sequence of who has been informed and (b) whether the next trader is optimistic or pessimistic. In a similar fashion, total volume after everybody has been informed depends on the path by which the final market equilibrium is reached. It then becomes a random variable, and simulation indicated that volume is highest when investors are all optimists or all pessimists; in addition, that the absolute price change is lowest at the same percentage of optimists at which volume is lowest, and

[2] In what follows, trading activity will alternately be referred to as "volume" or "turnover". The former is the less precise term used in the theoretical discussion, where the latter term is the operational measure of trading activity, adjusted for the existing number of a firm's shares, on a market value basis.

[3] This is equivalent to assuming that borrowing costs are infinitely high, or that short selling is not allowed by market regulators.

that it rises with volume, and this evidently supports a positive covariance between volume and absolute price change.[4]

In addition, because it is always more expensive to short sell, the volume associated with a price increase tends to be higher than with an equal price decrease, given that costly short sales would restrict some investors' abilities to trade on new information.

As mentioned in the Introduction, Karpoff (1987) listed 18 papers that measured the covariance between volume and the magnitude of price changes. With one exception, these papers found positive covariances between volume and the magnitude of price changes in various U.S. markets. In particular, 10 of such papers examined the covariance for individual stocks, including the paper by Wood et al. (1985) that covered approximately 1,000 individual stocks, using minute-by-minute data in the 1971-1972 period. With this exception, in addition of four other papers, all papers surveyed used daily data. The only paper that did not obtain evidence for a positive covariance between volume and $|\Delta p|$ used only stock market aggregates and three individual stocks. (GODFREY et al., 1964)

Saatcioglu and Starks (1998), building on the analysis by Karpoff (1987), tested the hypothesis of positive contemporaneous covariances between turnover and both signed returns and the magnitude of returns for six Latin American markets, including Brazil, using monthly data for the corresponding market indices, as calculated by the International Finance Corporation (IFC) in its Emerging Markets Data Base (EMDB). The period covered was from January 1986 through April 1995. The authors argued that their contribution consisted in ascertaining whether the results for the US market – generally positive covariances, as mentioned above - would be confirmed in markets with different institutional and informational arrangements. It is pointed out in their paper that knowledge of the existence of such covariances would be relevant for: (a) the assessment of competing theories about information dissemination; (b) the implementation of event studies in which both price and volume changes are used; (c) the consideration of the possibility that volume may determine the probability distribution of rates

[4] In his survey, Karpoff (1987) also discusses models for the covariance between trading activity and signed price changes. These models include a role for costly, allowed short selling. However, they are not discussed here because it is the covariance with absolute, not signed changes that is of interest.

of return; and (d) the justification of uses of technical investment analysis, as is also pointed out in Blume et al. (1994).

The specification used was:

$$VS_t = \beta_0 + \beta_1 |R_t| + \varepsilon_t \quad (1)$$

Where,

VS_t = spot market turnover for the local market index, t = 1,…, 96 months

$|R_t|$ =absolute value of returns on the local market index, t = 1,…, 96 months

The V-shaped relationship obtains when β_1 is positive. With local currency returns, the estimated value of β_1 for Brazil was equal to 0.0091, with a standard error of 0.98, and therefore not significantly different from zero. The expected positive results were obtained for four other markets, however: Chile, Colombia, Mexico and Venezuela.[5] The authors concluded that the variety of results would be explained by different institutional and informational arrangements in such emerging markets.[6]

Figures 1 and 2 display the data for two cases selected from the sample, as illustrations of the-shaped relationship between volume, as measured by turnover, and (signed) price changes.

[5] The result for Argentina was not significant either: 0.0028, with a standard error of 0.43.
[6] The same qualitative result for Brazil was obtained when U.S. dollar returns were used.

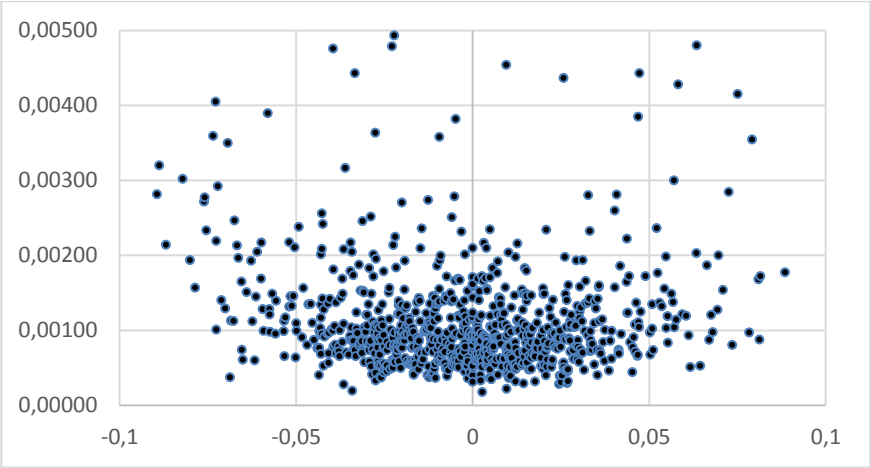

Figure 1
Scatter plot for daily turnover (vertical axis) versus signed daily price changes (horizontal axis), GFSA3 (Gafisa ON), the individual stock with highest estimated β_1 in equation (1), Jan. 05, 2010 to Jun. 28, 2013.

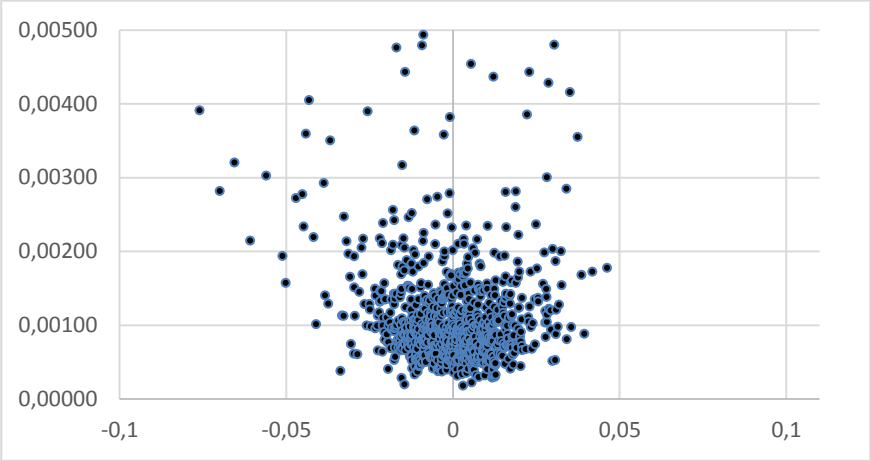

Figure 2
Scatter plot for daily turnover (vertical axis) versus signed daily price changes (horizontal axis), TRPL4 (Transmissão Paulista PN), the individual stock with highest R^2 in equation (1), Jan. 05, 2010 to Jun. 28, 2013.

Blume et al. (1994) argue that "volume captures the important information contained in the quality of traders' information signals" (p. 177). In other words, volume (turnover) may contribute to improve the knowledge of value fundamentals, instead of representing only market noise. The authors, with the adoption of a fixed stock supply assumption,

demonstrate that market participants learn about value with the use of past data of both price and volume, which would justify the common technical analysis approach of extrapolating future price behavior from the past.

It is also shown that volume is associated with dispersion of beliefs, and that it has content both when it is high and when it is low. This would result in the convex or V-shaped relationship explained by Karpoff (1987): the lowest volume would be attained when current market price is equal to the prior of the stock's expected value, although volume would not be zero even in this situation.

Finally, Blume et al. (1994) claim that, given the positive covariance between turnover and the magnitude of price changes, turnover data would be more useful for less followed stocks, since the quality of information is more limited for them, and that this would render technical analysis more useful for such stocks.

Watanabe (2001) studies the interaction of volatility (i.e., price change), volume and open interest in the Nikkei index futures market, where open interest is used as a proxy for market depth, i.e., the flow of orders that would be capable of causing price changes. He separates unexpected from expected volume, with unexpected volume being estimated with regression residuals in a model in which volume series are explained by the absolute value of price changes, and both lagged volume and lagged open interest. He also observes a positive association between (unexpected) volume and price changes, but that the impact of unexpected volume on prices is asymmetric, the positive impact being stronger the negative impact.

2.3. On the volume-price change relationship with a role for stock borrowing and lending

The previously reviewed literature mostly ignores the fact that there may also be another important market segment. In addition to the *spot* stock market, in which investors can only take on new long positions or simply liquidate previously held long positions, there is commonly a market for borrowing and shorting stocks, in exchange for the payment of a lending fee. In addition to institutional constraints, such as the uptick rule in the US market, such constraints at the individual security level is represented by the lending fees, which can vary substantially from one stock to another, in addition to general collateral requirements and/or

regulations. The determinants of lending fees were analyzed in D'Avolio (2002), for the US market, and in Rochman and Minozzo (2011) for the Brazilian market.

An analysis of the role of short sale constraints in the spot price determination process is the paper by Miller (1977), where the argument was made that, in the presence of both short sale constraints and dispersion of beliefs, stocks would tend to be overvalued. "Miller (1977) theorizes that short-sale constrained securities become overpriced when investors disagree about their value. In his model, overpricing develops because pessimists are restricting to owning zero shares when actually wish to hold a negative quantity, and the price of the security is set by the beliefs of the most optimistic investors." (BOEHME, et al., 2006, p. 455)

Boehme et al. (2006) show that both conditions (short sale constraints and dispersion of beliefs) are necessary for overvaluation, and they implement both a short-term (one month) and a long-term (one year) analysis of abnormal returns, finding negative abnormal returns that are positively associated with both dispersion of beliefs and the level of short sale constraints. A partial analysis also reveals that neither condition would be sufficient, by itself, for stock overvaluation. However, if short sale constraints play a role in limiting the implementation of an information dissemination process that materializes through trading activity and price changes, one would expect that they activity in the market used for generating opportunities for short selling would have a conditioning influence in the relationship between spot market activity (volume, or turnover) and absolute price changes. In other words, the expected V-shaped relationship between volume and price changes could be more or less intense when one accounts for lending market activity.

Baker and Stein (2004) construct a model that explains how liquidity increases (i.e., higher turnover) could anticipate lower prices, implying a negative covariance between lagged turnover and returns. It is shown that, in the presence of short selling constraints, the existence of irrational investors would cause the overvaluation of stocks, as in Miller (1977). Since irrational investors would be responsible for increases in liquidity, such increases would signal that the market is dominated by such investors, with the inference that prices are "high". This, in turn, indicates the need for accounting for non-contemporaneous measures of volume and price changes, given the existence of short selling opportunities.

Duffie et al. (2002) contributed to the literature with the development of a dynamic model containing a role for short sale

constraints. Their paper considers the same factors as in Miller (1977), with short sale constraints represented by lending fees and the difficulty of locating securities to sell, and dispersion of beliefs, and obtains the same overvaluation result. The novel result is the conclusion that overvaluation may be more substantial with some shorting than without any shorting, since a reduction in the dispersion of beliefs about a stock's value will tend to decline with the issuing firm's "age" in the market – the "learning" process documented by Pastor and Veronesi (2003) - thus compensating for the effect of the short sale constraints.

3. Hypotheses

This paper uses individual stock data to test whether the V-shaped relationship between volume (turnover) in the spot market and price changes (returns), without and with the inclusion of lending market turnover on the same day, for the same individual stock, seems to hold in the Brazilian market.

As indicated above, the null hypothesis, specified with the help of equation (1), is that β_1 is non-positive, whereas the expected result is that of a positive and significant coefficient.

A second specification is also used, in which to equation (1) a variable representing activity in the stock lending market is added:

$$VS_{j,t} = \gamma_{0,j} + \gamma_{1,j}\left|R_{j,t}\right| + \gamma_{2,j}VL_{j,t} + \nu_{j,t} \quad (2)$$

Where:

$VS_{j,t}$ = spot market turnover for stock j on day t

$\left|R_{j,t}\right|$ =absolute value of returns on stock j = on day t

$VL_{j,t}$ = lending market turnover for stock j on day t

One could argue that, if equation (1) were the correct specification, one would be dealing with a market in which stock borrowing and lending would not be allowed, increasing the strength of the spot market trading volume and therefore the magnitude of the (positive) slope coefficient. When a borrowing and lending market exists, as represented by equation (2), one would expect a reduction in the constraints considered in the various models heretofore described. Hence, an attenuation of the slope coefficient relating VS to absolute price changes

would be observed. The second null hypothesis, therefore, is that the mean of γ_1 values, in equation (2), is lower than the mean of β_1 values in equation (1).

4. Variables and data sources

The analysis is performed with daily data for 47 individual stocks traded at the BM&FBovespa, involving 44 different issuing companies. The data series covers the period from January 04, 2010 to June 28, 2013, for a total of 864 price change and volume observations. The securities were selected under the restriction that they were traded every day during this period, both in the spot market and the market for security borrowing and lending. The list of securities in this sample is provided in Table A.1, in the Appendix, along with descriptive statistics on trading activity in both the spot and the lending/borrowing markets.

Table A.1 clearly shows the relevant level of trading in the lending market, representing, on average over the period, almost 80% of the turnover in the spot market.[7] For nine companies the ratio is higher than unity (100%).

Spot market price and volume (monetary value of transactions) data were collected in the Economática data base. Volume data were converted into turnover data in order to standardize volume information, where turnover is the ratio between volume and individual firm market capitalization. Prices were adjusted for dividends and other corporate distributions, and returns were computed as the logarithm of the ratio of consecutive daily prices.

Turnover was also calculated, in a similar fashion, for the same individual stocks in the borrowing and lending market. This type of information is available, on a daily basis, in the BM&FBovespa site, specifically, at http://www.bmfbovespa.com.br/BancoTitulosBTC/EmprestimoRegistrado.aspx?Idioma=pt-br.

[7] Obviously, trading in the lending market produces trading in the spot market, but not necessarily during the same daily trading session. The ratio between turnovers in the two markets is used here only as an indication of how significant the lending market has become. However, as indicated by the correlation between daily changes in the turnover level in the two markets (0.0268, on average across the sample stocks), there is significant separation between the contemporaneous daily trading activities in the two markets.

5. Methodology

As in most studies surveyed by Karpoff (1987), and as implemented in Saatcioglu and Starks (1998), we estimate the following two specifications, using the ordinary least squares estimator with the Newey-West option in Eviews 7, in order to control for error heteroscedasticity and autocorrelation:

$$VS_{j,t} = \beta_{0,j} + \beta_{1,j}\left|R_{j,t}\right| + \varepsilon_{j,t} \quad (1)$$

$$VS_{j,t} = \gamma_{0,j} + \gamma_{1,j}\left|R_{j,t}\right| + \gamma_{2,j}VL_{j,t} + \nu_{j,t} \quad (2)$$

Where:

$VS_{j,t}$ = spot market turnover for stock j = 1,…, 47, on day t = 1,…, 864

$\left|R_{j,t}\right|$=absolute value of returns on stock j =1,…, 47, on day t = 1,…, 864

$VL_{j,t}$ = lending market turnover for stock j =1,…, 47, on day t = 1,…, 864

In equation (1), the hypothesis of a V-shaped relationship between volume and price changes for any particular stock j will be supported if β_1 is significant and positive. In equation (2), the focus is on whether the inclusion of VL, as a determinant of VS, affects the results observed in the estimation of equation (1): the concern is with both the significance of VL, in which case equation (1) would suffer from an omitted-variable problem, and the impact on the association between volume and the magnitude of returns (the eventual V-shaped relationship), as denoted by how different are the estimated values of β_1 and γ_1. Given the discussion in the literature, it is expected that, on average, γ_1 is lower than β_1.

In this case, where we are examining results for individual stocks, the overall strength of the V-shaped relationship can vary substantially from stock to stock, as measured by the regressions' coefficients of determination (R^2). Lower R^2 values will indicate weaker association, and one can examine whether those values can be explained by certain individual firm and/or stock characteristics.

6. Results

Table 1 contains a summary of the results of the estimation of equation (1) for all 47 individual stocks included in the sample. In the estimation of β1, all 47 results were both positive and significant at the 5% level or lower.

Table 1

Summary of results for the estimation of equation (1): $VS_{j,t} = \beta_{0,j} + \beta_{1,j}\left|R_{j,t}\right| + \varepsilon_{j,t}$, j = 1,…, 47, t = 1,… 863.

Results for	Mean	Median	Maximum	Minimum
β_1	0.0875*	0.0596	0.3988	0.0102
Adjusted R^2	0.2043	0.1877	0.4798	0.0550

Note: * p-value for the mean = 0.0236.

The results listed in Table 1 provide overwhelming evidence in favor of a V-shaped relationship between volume, as proxied by turnover, and price change, since all slope coefficients are not only positive but significant.[8] Thus, there appears to be positive covariance between volume and the magnitude of price change in the Brazilian stock market, lending support to the contention that volume, as a market statistic, contains information not fully impounded into prices. The highest estimated values for the association between turnover and price change magnitude were obtained for GFSA (Gafisa, 0.3988) and OGX (OGX Oil and Gas, 0.3094). The former security is not very liquid, while the latter was one of the most actively traded issues in the sample period. This indicates that liquidity, or lack thereof, is not a sufficient explanation for the association obtained, but suggests further study in the determination of the cross section of such turnover-return sensitivities.

Table 2 contains the summarized results of the estimation of equation (2) for all 47 individual stocks included in the sample. For the variable representing the association between turnover (VS) and the magnitude of stock market returns (R), all 47 results are positive and significant at least the 5% level. The weakest result obtained with equation (1), for the Usiminas stock, was improved with the addition of the variable representing turnover in the stock lending market: the result is now significant at the 1% level.

[8] For only one stock (USIM3, or Usiminas ON) is the result not significant at the 1% level; p-value is equal to 0.0386.

Regarding the explanatory power of lending market turnover (VL) to spot market turnover (VS), the mean of the 47 individual results is positive, with a p-value of 6.5%. A large majority of the estimated values for γ_2 is positive (43, to be exact, of which 40 are significant at the 5% level). It is particularly worth noting that the maximum estimated value was obtained for the OGX stock, notorious for the speculation movements surrounding this security over the sample period. It is apparent that highly speculative stocks, already the subject of intense lending/shorting activity, contribute strongly to spot market turnover.

Table 2

Results for the estimation of equation (2): $VS_{j,t} = \gamma_{0,j} + \gamma_{1,j}\left|R_{j,t}\right| + \gamma_{2,j}VL_{j,t} + \nu_{j,t}$, j = 1,…, 47, t = 1,… 863.

Results for	Mean	Median	Maximum	Minimum
γ_1	0.0822*	0.0595	0.3761	0.0108
γ_2	0.1626**	0.1198	1.3834	-0.1460
Adjusted R^2	0.2447	0.2104	0.7231	0.0278

Note: *p-value for the mean = 0.0208; **p-value for the mean = 0.0652.

The results reported in Table 2, taking into account the eventual association between turnover in the spot and the lending markets, and correcting for a possible specification error, indicate that the evidence for the V-shaped relationship between spot market volume and spot market price changes is still very solid: absolute price changes continue to be significantly positive.

In addition, and for methodological robustness's sake, equations (1) and (2) were estimated in panel data format, with fixed effects for both stock j and day t, and with clustering by cross section. The results are displayed in Tables 3 and 4.

Table 3

Panel data estimation of equation (1), $VS_{j,t} = \beta_{0,j} + \beta_{1,j}\left|R_{j,t}\right| + \varepsilon_{j,t}$, with fixed effects for both stock j and day t. Dependent variable: VS = spot market turnover.

Variables	Coefficient and standard error
Constant	0.0026*
	(0.0000)
Absolute value of daily return	0.1209*
	(0.0052)
Adjusted R^2	0.5807

Note: *Significant at the 1% level.

Table 4

Panel data estimation of equation (2), $VS_{j,t} = \gamma_{0,j} + \gamma_{1,j}\left|R_{j,t}\right| + \gamma_{2,j}VL_{j,t} + \nu_{j,t}$, with fixed effects for both stock j and day t. Dependent variable: VS = spot market turnover.

Variables	Coefficient and standard error
Constant	0.0019*
	(0.0001)
Absolute value of daily return	0.1166*
	(0.0046)
Lending market turnover	0.3076*
	(0.0497)
Adjusted R^2	0.6067

Note: *Significant at the 1% level.

The results in both Tables 3 and 4 confirm the individual ordinary least squares results presented in Tables 1 and 2, for the existence and significance of the V-shaped relationship between daily turnover and returns, and for the significance of lending market turnover for spot market turnover. If anything, the use of the panel data estimator increased the magnitude of the relevant coefficients, adding greater strength to the original results.

7. Conclusion

The analysis in this paper provides very strong evidence in favor of positive covariance between daily trading volume in the BM&FBovespa equity segment and the absolute value of daily price changes. This clearly means that volume statistics, proxied by turnover, contain information that may contribute to a better description of the return process. In this sense, the results differ from the weaker evidence obtained for the Brazilian market in Saatcioglu and Starks (1998). The main implication, however, is that price change series are not sufficient statistics to explain the pricing of stocks in a market like the BM&FBovespa.

The results indicate that additional and significant information for describing the return generating process is associated with contemporaneous trading volume data, representing quantities supplied and demanded, presumably functions of the arrival of new fundamental information, albeit in a sluggish manner. This creates a role for the proposition, from Technical Analysis, that price changes can at least be explained by trading information, and that current prices would not contain all relevant information, as propounded by the efficient market hypothesis.

The paper also considered including a proxy for the trading activity in the stock lending market, which has increased substantially in the last few years, and the possibility of interaction between spot and lending markets has frequently been considered in the literature. The inclusion of a proxy for volume in the lending market did not alter the previous results in any significant way.

Even though the positive covariance between volume and price changes is widespread, its intensity varies from one stock to another. There is always the possibility that such intensity may be explained by specific security and/or issuing firm characteristics. That may be considered as a natural extension of this analysis, in an attempt to explain the cross section of measured covariances.

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Appendix

Table A.1
Descriptive statistics for the securities included in the sample

STOCK	CODE	TURNL/TURNS	CORR(VL,VS)
BANCO DO BRASIL ON	BBAS3	0.6970	0.2259
BRADESCO ON	BBDC4	1.0849	-0.0128
BRADESPAR PN	BRPA4	0.3343	0.0616
B2W DIGITAL ON	BTWO3	0.7230	0.1487
BMFBOVESPA ON	BVMF3	0.7464	0.0429
CCR ON	CCRO3	0.4365	0.0002
CESP PNB	CESP6	0.9690	-0.0258
CIELO ON	CIEL3	0.9274	0.0361
CEMIG PN	CMIG4	0.9053	0.1423
CPFL ENERGIA ON	CPFE3	1.6524	-0.0600
SOUZA CRUZ ON	CRUZ3	1.2164	0.0610
COSAN ON	CSAN3	0.5468	-0.0273
SID NACIONAL ON	CSNA3	0.6419	0.0281
CYRELA ON	CYRE3	0.8663	0.0852
ELETROBRAS PNB	ELET6	1.0412	0.0373
EMBRAER ON	EMBR3	0.5740	0.0407
FIBRIA ON	FIBR3	0.7706	0.1188
AES TIETÊ PN	GETI4	0.9141	-0.0757
GAFISA ON	GFSA3	0.4604	0.0962
GERDAU PN	GGBR4	0.5076	-0.0907
GERDAU MET PN	GOAU4	0.4908	0.0195
GOL PON	GOLL4	0.4418	0.0596
ITAUSA PN	ITSA4	0.7987	-0.0183
ITAUBANCO PN	ITUB4	1.0309	0.0235
JBS ON	JBSS3	0.5667	-0.0171
KLABIN PN	KLBN4	1.1129	0.0054
LOJAS AMERICANAS PN	LAME4	1.3389	0.0025
LIGHT ON	LIGT3	0.6505	0.0523
LLX LOG ON	LLXL3	0.3762	-0.0662
LOJAS RENNER ON	LREN3	0.8931	-0.0228

Cont. Table A.1
Descriptive statistics for the securities included in the sample

STOCK	CODE	TURNL/TURNS	CORR(VL,VS)
MMX MINERAÇÃO ON	MMXM3	0.4313	0.0387
MRV ON	MRVE3	0.9817	0.0737
NATURA ON	NATU3	1.3744	0.1106
OGX PETROLEO ON	OGXP3	0.3536	0.1400
PDG REALTY ON	PDGR3	0.6220	0.0210
PETROBRAS ON	PETR3	0.8642	-0.0624
PETROBRAS PN	PETR4	0.6190	-0.0237
ROSSI RESIDENCIAL ON	RSID3	0.4918	0.0321
SANTANDER UNIT	SANB11	0.9838	0.0588
SABESP ON	SBSP3	0.5397	0.0588
SUZANO ON	SUZB3	0.5359	0.0013
TRACTEBEL ON	TBLE3	1.4847	-0.0152
TRANSMISSÃO PAULISTA PN	TRPL4	0.8377	0.0803
USIMINAS ON	USIM3	0.7527	-0.0192
USIMINAS PNA	USIM5	0.7254	0.0645
VALE ON	VALE3	0.9353	-0.1351
VALE PNA	VALE5	0.7743	-0.0348
AVERAGE		0.7877	0.0268
STANDARD DEVIATION		0.3049	0.0690
MAXIMUM		1.6524	0.2259
MINIMUM		0.3343	-0.1351

Notes: TURNL/TURNS = Ratio between average daily turnover in the lending (L) market and average daily turnover in the spot (S) market, Jan. 04, 2010 to Jun. 28, 2013.
CORR(VL, VS) = Correlation between daily changes in turnover in the lending market (VL) and daily changes in the spot market (VS), where V denotes first differences in both turnover measures.