Short-Sale Constraints, Differences of Opinion, and Overvaluation: A Test of the Overpricing Hypothesis in the Brazilian Stock Market

**Autoria:** Antonio Zoratto Sanvicente

Resumo

Under the realistic conditions of restrictions on short selling and divergence of opinions about the values of stocks, stocks would be overprices, according to Miller (1977). The paper uses daily stock lending market data, in addition to information on the sample stocks, for a period of 42 months in 2010-2013, to test the overpricing hypothesis in the Brazilian market. The results support the hypothesis and indicate that the impact of short-sale constraints on returns does not disappear before 10 days have passed.
I. Introduction

Miller (1977) proposed that, under short-sale constraints, securities would become overpriced if investors had different opinions about their intrinsic values, whereby some investors would be pessimistic and others would be optimistic about those securities.

That proposition was explained as follows. Under the extreme condition of short-sale prohibition, pessimistic investors would be restricted to owning zero shares, whereas the optimal quantity demanded at current prices would be negative. Therefore, prices would be set by optimistic investors. This means that, in general, securities would become overvalued.

A less extreme version of short-sale constraints would include the existence of costs for short selling, as reflected in rental fees paid by stock borrowers to their lenders; the higher the rental fee, the more serious would the short-sale constraint be.

This paper tests the Miller (1977) proposition as a hypothesis for the Brazilian stock market, using both cash and lending market data for actively traded individual securities. One empirical implication of overpricing under those conditions would be the occurrence of abnormal returns following the simultaneous observation of both short-sale constraints and differences of opinion, proxied by rental fees and stock turnover, respectively. In addition, one should find an inverse relationship between abnormal returns and both rental fees and turnover. If abnormal returns can be observed for a number of days after the market receives information on rental fees and turnover, then a trading rule might be structured in order to profit from that information. If so, evidence against semi-strong form efficiency would have been obtained.

The following section in this paper first describes the Miller (1977) proposition in more detail, and comments on literature building on the proposition and testing it for both the U.S. and the Brazilian markets. The subsequent sections describe the methodological approach to testing it in the Brazilian market, including the data used. The results are finally presented and the paper concludes.

II. Review of literature: the Miller (1977) hypothesis

An analysis of the role of short-sale constraints in the spot price determination process is done in Miller (1977), where the argument was made that, in the presence of both short-sale constraints and dispersion of opinions about intrinsic value, 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 they 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 significantly associated with both dispersion of opinions and the level of short-sale constraints. A partial analysis also reveals that neither condition would be sufficient, by itself, for stock overvaluation: “Indeed, in Miller’s model, if a stock is subject to short-sale constraints but there is no disagreement about firm value, there are no optimists or pessimists in the markets and the stock will not be overpriced. Likewise, if there is high dispersion of beliefs but no short-sale constraint, both the optimists and pessimists will be able to trade (on
opposite sides) and the market value will reflect the mean valuation over the cross-section of investors. On average, these stocks will also not be overvalued.” (BOEHME et al., 2006, p. 455-456)

The authors construct a two-dimensional framework in order to account for both conditions at the same time. Their tests indicate that only when their interaction is taken into account does overpricing occur. And their results show that “stocks are not systematically overvalued when either one of these two conditions is not met.” (BOEHME et al, 2006, p. 455)

Following the publication of Miller (1977), Baker and Stein (2004) constructed 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 (returns), given the existence of short-selling opportunities.

Duffie et al. (2002) developed 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, in addition to 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.

III. Hypothesis

The present paper tests the Miller (1977) proposition for the Brazilian stock market using the following basic specification:

\[ ER_{j,t} = \alpha_j + \beta_{1,j} FEE_{j,t} + \beta_{2,j} TURN_{j,t} + \beta_{3,j} X_{j,t} + \epsilon_{j,t} \]  \hspace{1cm} (1)

Where:

- \( ER_{j,t} \) = excess return for stock \( j \) on day \( t \);
- \( FEE_{j,t} \) = rental fee for stock \( j \) on day \( t \) in the stock lending market;
- \( TURN_{j,t} \) = turnover for stock \( j \) on day \( t \) in the stock cash market;
- \( X_{j,t} \) = set of common risk factors determining returns for stock \( j \) on day \( t \);

Section IV provides additional and more detailed information on how the variables are measured and equation (1) is estimated. For the moment, it is important to highlight the use of the FEE and TURN explanatory variables.

FEE is the proxy for short-sale constraints, and is measured by the observed rental fees in the stock lending market of interest in this paper (the São Paulo stock market). In the literature reviewed by Boehme et al. (2006), the following proxies for short-sale constraints are
discussed: (a) short stock rebate rates; (b) relative short interest; (c) option status. These were variously proposed in other studies due to the opaqueness of the U.S. stock lending market and the difficulty of directly observing lending or rental rates at the time the studies were prepared. They were also used by Boehme et al. (2006), who construct a composite measure of short-sale constraints by combining all three proxies.

Jones and Lamont (2002) argued for the use of the rebate rate (the portion of interest or dividends earned by the stock lender that is paid to the stock borrower – i.e., the short seller); clearly, the higher the rebate rate, the lower the constraints on short-selling a particular stock. The second proxy – relative short interest, that is, the total number of shares sold short divided by the number of shares outstanding - is mentioned as the most commonly used proxy in previous U. S. studies. Figlewski (1981) proposed using relative short interest with the argument that the unobserved demand for shorting a security would rise with the level of observed short sales. In addition, this would be an easier variable to use in empirical studies, since short interest data are provided by the NYSE and the NASD, and the daily series are available in digital form for the period beginning in January 1988.

Finally, “option status”, as a proxy, represents the existence of exchange-traded options on stocks. The argument is that, if options are traded on a particular stock, then that stock is less short-sale constrained, since investors would be able to speculate on price declines by trading in calls and/or puts. Both Figlewski and Webb (1993) and Daniels and Sorens (2001) have confirmed this.

In the U.S. market, rebate rate and rental fee information are not provided in a centralized fashion. Researchers often have to resort to accessing data from individual market makers. In the Brazilian market, in spite of the less than desirable public access to daily data for the stock lending market, both relative short interest and rental fee data are available, in a centralized fashion, for individual securities and for a long enough period.

Concerning dispersion of opinion, Boehme et al. (2006) discuss three proxies that have been previously used: (a) I/B/E/S (International Brokers’ Estimate System) analyst forecast dispersion, measured by the ratio between the standard deviation of analyst earnings/share forecast for the current fiscal-year end and the absolute value of the mean earnings/share forecast; (b) idiosyncratic firm volatility, measured by the standard deviation of the error terms from the Brown and Warner (1985) market model; (c) turnover, or the ratio between trading volume and the number of shares outstanding. The three alternative proxies are used by Boehme et al. (2006) for robustness purposes.

Boehme et al. (2006) perform partial tests of the relationship between excess returns, adjusted with the four-factor model of Fama and French (1993) and Carhart (1997), and conclude that, by itself, neither a proxy for short-sale constraints, nor a proxy for dispersion of opinion is sufficient by itself to explain adjusted excess returns. However, when the interaction – in the sense of including both types of proxies – between short-sale constraints and dispersion of opinion is considered, then the hypothesized results are observed: abnormal returns are more negative the stronger the constraints and the wider the dispersion of opinion.

In this paper, the hypotheses formally tested are that both $\beta_1$ and $\beta_2$ are negative in equation (1), and we seek confirmation, for the Brazilian market, of the results obtained by Boehme et al. (2006). Subsequently, those two parameters are estimated with lagged values of FEE and TURN, in an attempt to verify whether the corresponding information is promptly impounded into current prices. If it is not, it might be possible to create a profitable trading rule using that publicly available information.
De-Losso et al. (2013) have recently tested the overpricing hypothesis resulting from the combination of short-sale restrictions and dispersion of opinion about individual stocks in the Brazilian market. Using panel data estimation and information for 44 individual stocks in the January 2009-to-July 2011 period, they regressed future returns (1 to 4 weeks ahead) on short interest data (defined as the ratio between the number of shares offered for lending and the number of shares outstanding for each stock) and daily total volatility (calculated with unadjusted daily returns over the preceding 50 days), the latter as a measure of dispersion of opinion.

These authors claim that their contribution is in the direct observation of shifts in the lending supply, made possible by the centralized structure of the Brazilian market. The future returns are adjusted for size and the book/market ratio, and they add that adjustment for market returns (FAMA and FRENCH (1993)’s third factor) did not modify their results. Current returns are also used as a control variable, in order to correct for the possible correlation between returns and shifts in lending supply\(^\text{v}\), and hence the possibility of momentum or reversal. In the present paper, we correct for momentum or reversal explicitly, as part of the four-factor pricing model. Their results confirm not only that both short-sale restrictions and dispersion of opinion predict future returns in the expected direction, but also that the restrictions and the dispersion of opinion reinforce each other, with the observation of a significant interaction term.

IV. Methodology: variables and data sources

The basic data in our analysis consists of daily returns (log price ratios) for 50 individual stocks. Those securities have the common characteristic of including the most actively stocks in both the cash and the lending markets, since one data limitation imposed was that they were traded every day in the period between January 04, 2010 and June 28, 2013, for a total of 863 daily return observations.

As pointed in Rocha da Mota (2014), the Brazilian market environment is uniquely suited for this type of analysis, due to the centralization of all lending transactions in a single stock exchange and clearing organization. This framework was implemented with a service created by the BM&FBovespa in 1996, through the “Banco de Títulos – BTC” system. This system provides for registration, risk control, settling and custody services, and also the publication of lending market information.

Some of the transaction information, especially on a daily, aggregate basis, for each individual security, is publicly available\(^\text{vii}\). The Rocha da Mota (2014) study is partly descriptive and analytical. Of interest to the current paper is, for example, the finding that lending fee and turnover are positively correlated, after adjusting for individual stock volatility, in a panel data analysis covering the 2007-2013 period\(^\text{viii}\). It is also mentioned that the size of the lending market grew by 23.5% per annum, in that period, when measured by loan balance – the market value of shares borrowed on a daily basis. Towards the end of the period, the loan balance for the most actively lent stocks even surpassed the volume traded on their respective cash market at the BM&FBovespa: the average turnover ratio, between the lending market and the cash market, for those 50 securities, was equal to 78,77% in the January 04, 2010-to-June 28, 2013 period, with a maximum of 148,47% for Tractebel ON.
Daily excess returns (EXCRET) were measured as the differences between individual stock returns and the log price ratio series for Economática’s CDI index. Both stock prices and the CDI index were obtained in the Economática database.

Lending fee data (FEE) for the sample individual stocks were downloaded, on a daily basis, from the BM&FBovespa website (http://www.bmfbovespa.com.br/BancoTitulosBTC/EmpréstimoRegistrado.aspx?Idioma=pt-br).ix

Daily turnover (TURN) was measured as the ratio between daily volume in the cash market and the market capitalization for each individual stock, also available at the Economática database.

Excess returns were adjusted for both market returns only, as measured by log price ratio of the Ibovespa, in excess of the CDI index returns, and the Fama-French (1993) and Carhart (1997) common risk factors. Therefore, size, value and momentum indices were constructed, and in the following manner.

Size, or SMB (small market capitalization minus large market capitalization), was measured on a daily basis, using equally-weighted returns for the 100 smaller companies in the equity segment of the BM&FBovespa (S), and equally-weighted returns for the 100 larger companies in the same segment over the period (B). Since data for 336 companies were initially available, this means that the returns for the middle 136 companies were not used.

Value, or HML (high book-to-market ratio minus low book-to-market ratio) was similarly constructed from the returns of 301 companies.x The middle 121 companies were excluded.

Momentum was computed with the difference between the equally-weighted average of the 30 stocks with the highest returns and the equally-weighted average of the 30 stocks with the lowest returns on the previous day. Therefore, this assumed that the momentum effect, if it existed, would cover only a single day.

V. Methodology: estimation procedure

Equation (1) was estimated initially with contemporaneous data in two versions: with an adjustment for excess market returns only, and for the three additional empirical common factors (SMB, HML and momentum). This was done for robustness purposes, in case there is uncertainty about the correctness of either pricing model.

Estimation was performed with panel data. The comparison of the random-effect versus the fixed-effect specifications with the application of the Hausman test indicated the situation as described by Wooldridge (2009, p. 493): “In practice, a failure to reject [random effects] means either that the RE and the FE estimates are sufficiently close that it does not matter which is used, or the sampling variation is so large in the FE estimates that one cannot conclude practically significant differences are significantly different.” The analysis of cross-section random effect comparisons in E-views indicated that RE and FE coefficients were not significantly different.

VI. Results
The estimation results for the two basic specifications, with the use of contemporaneous returns, are displayed in Table 1.

Table 1: Dependent variable: individual excess stock returns. Estimation with panel data of (a) single factor model of excess returns, with EXCMKT as the sole independent variable, defined as the daily difference between the returns on the Ibovespa and the CDI index; (b) four-factor model of excess returns, with EXCMKT; SMB (a proxy for size, measured as the returns on an equally-weighted stock portfolio of lower capitalization companies, minus the returns on an equally-weighted stock portfolio of higher capitalization companies); HML (a proxy for value, measured as the returns on an equally-weighted stock portfolio of high book-to-market ratio companies, minus the returns on an equally-weighted stock portfolio of low book-to-market ratio companies); MOMENTUM (a proxy for return persistence, measured as the returns on an equally-weighted portfolio of winning stocks on the previous day, minus the returns on an equally-weighted portfolio of losing stocks on the previous day). Standard errors in parentheses.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Single factor model</th>
<th>Four-factor model</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td>-0.0002</td>
<td>0.0004*</td>
</tr>
<tr>
<td></td>
<td>(0.0001)</td>
<td>(0.0001)</td>
</tr>
<tr>
<td>EXCMKT</td>
<td>0.6820*</td>
<td>0.6796*</td>
</tr>
<tr>
<td></td>
<td>(0.0063)</td>
<td>(0.0065)</td>
</tr>
<tr>
<td>SMB</td>
<td>0.0020</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0064)</td>
<td></td>
</tr>
<tr>
<td>HML</td>
<td>0.0448*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0128)</td>
<td></td>
</tr>
<tr>
<td>MOMENTUM</td>
<td>-0.0850*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0086)</td>
<td></td>
</tr>
<tr>
<td>Adj. R²</td>
<td>0.2127</td>
<td>0.2147</td>
</tr>
<tr>
<td>DW statistic</td>
<td>1.7146</td>
<td>1.7124</td>
</tr>
</tbody>
</table>

* Significant at the 1% level.
Source: The author.

The results in Table 1 indicate that, contrary to expectations resulting from the development of the empirical four-factor model, only the growth-versus-value factor is both significant and positively associated with stock excess returns, pointing to a premium on value stocks. The size factor is not significant, whereas the momentum factor, although significant, appears to be negatively associated with stock excess returns, implying that a reversal strategy based on price trends could be superior to trend following.

Next, we include the main variables of interest - FEE and TURN, the proxies for short-sale constraints and dispersion of opinion, respectively. The common risk factors analyzed in Table 1 now take on the role of control variables for risk. According to the previous discussion, it is expected that both FEE and TURN are negatively associated with EXCRET. These are now our independent variables.

The initial results for this more complete specification are provided in Table 2, using daily contemporaneous returns. Given that the inclusion of SMB, HML and MOMENTUM does not affect the coefficient on EXCMKT materially, and that both HML and MOMENTUM appear to be significant, only the four-factor specification is used from this point on.
Table 2  Dependent variable: individual excess stock returns. Estimation with panel data, using FEE – individual stock rental fee in the stock lending market – and TURN – individual stock turnover in the cash market - as independent variables. EXCMKT, SMB, HML and MOMENTUM are used as control variables for common risk factors. Standard errors in parentheses.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimated coefficients</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT</td>
<td>0.0011*</td>
</tr>
<tr>
<td></td>
<td>(0.0001)</td>
</tr>
<tr>
<td>EXCMKT</td>
<td>0.6795*</td>
</tr>
<tr>
<td></td>
<td>0.0065</td>
</tr>
<tr>
<td>SMB</td>
<td>0.0018</td>
</tr>
<tr>
<td></td>
<td>(0.0064)</td>
</tr>
<tr>
<td>HML</td>
<td>0.0462*</td>
</tr>
<tr>
<td></td>
<td>(0.0128)</td>
</tr>
<tr>
<td>MOMENTUM</td>
<td>-0.0805*</td>
</tr>
<tr>
<td></td>
<td>(0.0086)</td>
</tr>
<tr>
<td>FEE</td>
<td>-0.0000</td>
</tr>
<tr>
<td></td>
<td>(0.0000)</td>
</tr>
<tr>
<td>TURN</td>
<td>-0.1254*</td>
</tr>
<tr>
<td></td>
<td>(0.0205)</td>
</tr>
<tr>
<td>Adj. R²</td>
<td>0.2155</td>
</tr>
<tr>
<td>DW statistic</td>
<td>1.7140</td>
</tr>
</tbody>
</table>

* Significant at the 1% level.

Source: The author.

The results in Table 2 show that both independent variables (FEE and TURN) are negatively associated with individual stock excess returns, as previously argued, although the result for FEE is not significant at the 1% level. In addition, the inclusion of the two independent variables did not change the results for the factors used as adjustments for risk that had been included in Table 1.

The fact that rental fee and turnover data are public information, and the observation that they seem to be significantly associated with excess returns would naturally lead to the conjecture that they might be used as instruments in a profitable trading rule.

In a test for the necessary but not sufficient condition for the establishment of a profitable trading rule, one would consider whether the observation of rental fee and turnover data on day \( t-k \) could be used to invest or refrain to invest in stocks on day \( t \), with \( k = 1, 2, \ldots \).

Towards this end, the specification analyzed in Table 2 was estimated with the use of lagged values of both FEE and TURN, while the common risk factor indices were measured contemporaneously with EXCMKT. The results of such an exercise are presented in Table 3, with lags varying from \( k = 1 \) to \( k = 15 \) days.

Table 3  Dependent variable: individual excess stock returns. Estimation with panel data, using lagged values for FEE – individual stock rental fee in the stock lending market – and TURN – individual stock turnover in the spot market - as independent variables. Lags are from \( k = 1 \) to \( k = 15 \) days. Control variable (EXCMKT, SMB, HML and MOMENTUM) coefficients are not reported. Standard errors in parentheses.
Table 3 indicates that the significant negative association between rental fee and excess returns on individual stocks persists up to 10 days after the public observation of rental fee values, since it can be collected from the BM&FBOvespa website early in the morning of the following day, before the day’s market session opens. The negative association between dispersion of opinion and subsequent excess returns, however, dissipates within one day’s time. This clearly means that the rental fee data possess significant information content that might be used in the construction of a profitable trading rule.

VII. Conclusion

The present paper has tested the Miller (1977) overpricing hypothesis resulting from the existence of short-sale constraints and dispersion of opinion about individual stocks’ intrinsic values. The results confirm the hypothesis and are similar to those obtained by De-Losso et al. (2013)’s, even though they used different proxies for both conditions (to wit, short interest as a proxy for short-sale restrictions and past total volatility for dispersion of opinion), and seems to be robust even to their criticism of Boehme et al. (2006) for not controlling for shifts in demand.

The results also indicate that lending market information is not impounded fast enough to prevent the construction of a profitable trading rule with such publicly available information. Hence, as a suggestion of further studies, it would be interesting to actually construct and test a specific trading rule and measure the economic significance of the abnormal returns produced by that strategy.

In addition, an analysis of the cross-section and the individual time series of rental fee levels for individual stocks in the search for the determinants of rental fees could be illuminating.

Finally, another possibility for further study would involve the inclusion of options market data as an alternative proxy for short-sale restrictions.

VIII. References


---

i This means that, the stricter the short-sale restriction and/or the wider the divergence of opinions, the more negative is the abnormal return observed.

ii Boehme et al. (2006) used a set of portfolios of stocks classified independently along the two dimensions (short-sale constraints and dispersion of opinion) and tested for the association between abnormal returns and high levels of constraints and dispersion. In our paper, we use individual stock data, in the belief that grouping the stocks into portfolio is a less efficient use of information.

iii Boehme et al. (2006) used constraint data for the March 2001 to December 2002 period (22 months), while we work with daily data a period of 42 months.

iv Jones et al. (1994, p. 633) observe “the apparent consensus even among academics that volume is related to volatility because it reflects the extent of disagreement about a security’s value on either differential information or differences of opinion.” Hence, volume could be used as a proxy for volatility. We use turnover, which is a scaled version of trading volume.

v No mention is made of the use of returns in excess of a proxy for a risk-free asset.

vi For example, if returns are positive, investors may be induced to increase the shorting of stocks.

vii Rocha da Mota (2014), however, was able to obtain access to most of the non-confidential data on an individual contract basis. This was directly provided to her by the BM&FBovespa, and is not generally available to the public.
It could be conjectured that this indicates that demand has tended to outstrip supply, if stock lending and short sales are used in the implementation of long-short strategies. This, however, would be appropriately the topic for a paper on the determinants of lending fees.

Statistics on daily lending market activity are available only on a daily basis. There is no public file containing any historical series of this activity. However, retroactive data for short interest is available on the same site for a period of up to three months.

Book to market ratio was computed as the ratio between net worth per share and price per share. Companies with negative net worth were excluded, resulting 301 valid series.

It is significant at the 6% level, however.

This satisfies the Baker and Stein (2004) argument involving the association between lagged trading statistics and price changes.

The same qualitative results are obtained if the three empirical risk factors are not included.