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Market Efficiency in Brazil: some evidence from high-frequency data[*]

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Abstract

In this paper we used intraday data to assess market efficiency in Brazil. We used a database of prices and the number of shares traded of liquid stocks listed in Brazil's stock exchange, BM&FBOVESPA, and disclosures of material facts legally imposed by the Comissão de Valores Mobiliários (CVM), the Brazilian authority for the regulation of security markets. Our findings indicate material facts reported by firms indeed reveal unexpected information to investors. The speed of price response to new information and the observed magnitudes of cumulative returns indicate market participants can benefit from profit opportunities in the minutes close to the release of material facts. Our findings suggest stock prices take up to fifty minutes to incorporate the new information.

Keywords: market efficiency; event studies; intraday data.
JEL Classification: G14

1. Introduction

The hypothesis of efficient markets has been investigated at length since the late sixties, mainly after studies by Fama et al. (1969) and Fama (1970). In this paper we use intraday stock returns and a set of compulsory releases of material facts by publicly traded companies to assess market efficiency in Brazil. Specifically, we examine the semi-strong form of market efficiency by means of an event study, seeking primarily to evaluate how fast stock prices fully reflect all information publicly available.

Our empirical analysis builds on a high-frequency database, including minute-to-minute data on transaction prices and the number of shares traded of liquid stocks listed in Brazil's stock exchange, the Bolsa de Valores, Mercadorias e Futuros de Sao Paulo—BM&FBOVESPA. All intraday price and volume data were collected through computational routines from November 2012 to February 2014.

We pooled high-frequency data on stock prices and traded volumes with a set of public releases of material facts, provided by the regulatory authority of security markets in Brazil, the Comissão de Valores Mobiliários (CVM). Publicly traded companies are required by the CVM to fully disclose material facts to reduce informational asymmetries and insider trading. In practice, as soon as facts are recognized as material by publicly traded firms, files describing them must be electronically sent to the CVM, prior to disclosures in other communication channels, by means of an electronic system developed for this finality. After sending, files are immediately displayed on the websites of the CVM and BM&FBOVESPA along with the subject, day, hour and minute of every disclosure.

In order to perform our event study, we collected intraday transaction prices, traded volumes and the time of compulsory releases by publicly traded firms. Information on material facts was collected directly from the CVM's website. Our intraday data refer to the last transaction price and accumulated traded volume in each single minute. The combination of these two sets of financial information enabled us to evaluate how fast, in minutes, the publicly accessible information at zero cost was completely incorporated into stock prices. To complete our analysis we also examined changes in the number of shares traded in the minutes surrounding the news.

The availability of high-frequency data allowed us to examine stock price reactions and traded volumes in a very narrow time window surrounding each event. This resulted in a methodological advantage of this study in comparison to previous

event studies in Brazil, as the small time intervals allowed us to isolate the effects of compulsory releases from those triggered by other sources of price variation. The advantage of using intraday data to access the immediate impact of news and to reduce the noise sample has been largely stressed in the literature of event studies (see, for instance, Drienko and Sault (2013), Swanson (2011), Faust et al. (2007), Gürkainak et al. (2005), Busse and Green (2002) and Barclay and Litzenberger (1988)).

Summing up our results, we found disclosures of material facts indeed reveal new information to stock market participants in Brazil. Regarding market efficiency, we noticed that price adjustments to market news are not instantaneous, as the information released takes up to fifty minutes to be fully reflected into stock prices. Such results are robust with respect to the benchmark utilized to calculate abnormal returns, whether the Ibovespa index or a control group of firms, and also robust to penny stocks. The gradual adjustment of prices and the magnitude of minute-to-minute abnormal returns indicate profit opportunities for those traders who negotiate quickly after disclosures. As the number of shares traded increases in the first minute after the release of positive material news, as well as in the ninth minute after announcements of negative news, our results suggest market participants indeed react to these profit opportunities. To the extent that we identified increases in the number of shares traded in the minutes preceding the release of material facts, our results also pointed out anticipated trading activity.

The remainder of this paper is organized as follows. Section two discusses the literature about market efficiency hypothesis, highlighting studies with intraday data. Section three describes our database and the methodology used for testing abnormal returns. Section four presents the impact of compulsory releases on stock prices and traded volumes. We conclude the paper in section five.

2. Literature Review

Fama et al. (1969) introduced the methodology to evaluate the semi-strong form of market efficiency from the speed of price adjustments to specific types of new publicly available information, as stock splits or announcements of equity issues. Even nowadays this procedure remains the basis for event studies testing market efficiency in the semi-strong form (MacKinlay (1997), Campbell, Lo and MacKinlay (1997)). Prior

to Fama et al. (1969), most studies sought to assess market efficiency in the weak form from the observed independence of successive price changes.

In the United States, event studies using intraday data already have a long tradition in finance. Patell and Wolfson (1984) were among the first authors to use high-frequency data. They examined intraday effects of earnings and dividends releases provided by the Dow Jones News Service, an information platform available at that time on the floor of the New York Stock Exchange (NYSE). According to their results, the holding period return in the first thirty minutes from such releases was higher than any other thirty-minute returns verified in the same announcement day. Further, the highest numbers of extreme price changes were identified in the first four minutes following earnings announcements.

Barclay and Litzenberger (1988) inspected intraday data of common stock returns surrounding the announcements of new equity or debt issues between January 1981 and December 1983 by industrial firms listed on the New York or American Stock Exchange. They found an atypically large number of transactions recorded during the first fifteen minutes following the announcements of new equity issues. Stock prices fell on average 1.34% during this time interval. They calculated an average cumulative return of -2.44% between one hour before the disclosure of new equity issues and two hours after. Such results suggested profit possibilities for those who trade on the stock exchange during short periods before and after the publication of issues on new capital. The negative return observed supported the view that equity issues are interpreted as a signal that firms' managers believe the stocks are overvalued (Ball (1994), Hertzel et al. (2002)). Moreover, Barclay and Litzenberger report common stock returns were not statistically different from zero after announcements of new issues of long-term debt.

Since these initial studies, technological progress has reduced transactions costs in financial markets and hugely increased the availability of financial information to stock market participants. Whether or not the same profit opportunities through short selling trading strategies may exist nowadays in the Brazilian stock market is a pertinent question.

More recently, Busse and Green (2002) examined stock price reactions and trading in the US stock market using recorded data over fifteen-second intervals, the highest frequency theretofore applied in the literature on market efficiency. A chronometer was started by the authors at the exact time stocks were featured on the

Morning Call or Midday Call, television reports provided daily by the business news channel CNBC. These reports bring to viewers the latest updates potentially able to influence specific stock prices or segments of the stock market.

In their study, cumulative average returns started to rise two minutes before the disclosure of positive news by the Midday Call but stabilized at 0.5% three minutes after the first mention of the stock in this television report. The highest positive reaction was observed in the first two minutes after the release of good news. Negative on-air stock reports provoked a longer reaction in the cumulative average return: statistically significant effects lasted thirteen minutes from the moment bad news was given. The time sequence of statistically negative (and positive) average abnormal returns signaled that the US stock market incorporates news gradually, which entails profit opportunities for those who monitor the market more closely.

Drienko and Sault (2013) used intraday data to examine abnormal returns' behavior following firms' announcements in response to requirements from the Australia Securities Exchange (ASX) for further information releases to the market after unusual and large price and volume movements of firms' shares. They argued intraday data are useful to determine more precisely the length of time the market takes to impound the release of new information. By means of an event study approach, the authors found evidence that the market takes up to sixty minutes to reflect the information released.

In Brazil, Murcia et al. (2013) explored the effects of credit rating announcements made by the agencies Standard & Poor's and Moody's using daily stock returns in the Brazilian market during 1997–2011. Their findings indicated credit ratings do have informational content. Abnormal returns were statistically significant in days -1 and 0 for downgrades, upgrades and initial credit rating announcements. Particularly, downgrades were associated with negative abnormal returns in broader time windows, from -10 to 10 days relative to credit rating announcements.

In contrast to the US stock market, as far as we know there have been no prior studies about the informational efficiency of the stock market within the trading day in Brazil. Using high-frequency data, we believe our main contribution in this paper is to produce some evidence on market efficiency in Brazil using the behavior of stock prices and traded shares in the minutes surrounding the release of material facts.

3. Database and Methodology

Our intraday database includes transaction prices and traded volumes of all stocks listed on BM&FBOVESPA. Indeed, to perform this event study we selected stocks that exhibited, on average, a minimum of forty minutes of effective transactions per hour during the whole sample period. This was an important condition to avoid illiquidity effects in abnormal returns caused by stocks showing high bid–ask spreads. As discussed in the literature, the bid–ask spread is the cost to be paid for market participants to trade stocks immediately (Hautsch (2012), Krishnan and Mishra (2013)). Bid-ask spreads are also a proxy for market liquidity, as they are usually inversely related to measures of trading activity as frequency of trading, volume and number of transactions[1]. Hence, we excluded less liquid stocks to reduce market microstructure effects, since these stocks may present abnormal returns intrinsically, as a precondition for trading.

This liquidity criterion was also useful to preserve the high frequency of data, allowing a better view of stock prices' behavior in the minutes surrounding firm-specific announcements. Besides, the availability of high-frequency data allowed us to properly construct the empirical distribution of the average abnormal returns through bootstrap resampling.

BM&FBOVESPA is the largest stock exchange in Latin America in terms of market capitalization. It also provides central counterparty and securities custody services. Similar to the NYSE, its trading mechanism is characterized by a hybrid system, as most liquid stocks are traded directly among investors in an order-driven market while approximately two hundred of less liquid stocks are traded by designated market makers (specialists) in a quote-driven market. As the stocks employed in our event study already have high liquidity levels, none of them is traded by specialists.

Before statistical tests, each material fact was classified as positive or negative, according to the expected price reaction after the disclosure. Our evaluation relied primarily on the informational content of the files sent to the CVM, but in some cases it was also supported by press releases that helped us to assess prior expectations for events. As we did not examine the behavior of prices previously, we did not assume any form of market efficiency in advance.

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[1] See McInish and Wood (1992) for an extensive list of papers showing these results.

In our analysis, we considered only material facts disclosed during the trading time, which in Brazil is restricted from 10:00 a.m. to 5:00 p.m., in order to isolate the effects of the disclosures on stock prices and traded volumes through narrow time windows[2]. As shown in Table I, the material news included announcements of tariffs adjustments, equity issuance, regulatory intervention, cancellation of bonds' issuance, associations between firms and sale of shares aiming to reduce exposure to nonstrategic assets, among others. The date, hour and minute of the releases, as well as the subject and classification of each material fact, are also shown in Table I.

Table I - Material Facts

#	Date	Time	Company	Code	Subject	Evaluation
1	02/22/2013	15:54	Brookfield	BISA3	Cancellation of bonds issuance	Negative
2	03/11/2013	14:43	Cia. Vale do Rio Doce	VALE4	Suspension of investments	Positive
3	04/16/2013	11:16	Banco do Brasil	BBAS3	Regulatory intervention- suspension of bonds issuance	Negative
4	04/17/2013	13:01	Cia. Bras. de Distribuição	PCAR4	Regulatory authority aproves association	Positive
5	04/17/2013	12:47	Ecorodovias	ECOR3	Signing of concession contract	Positive
6	04/23/2013	11:01	Anhanguera	AEDU3	Association with Kroton Group	Positive
7	04/26/2013	15:31	Gol	GOLL4	IPO results	Negative
8	05/13/2013	12:12	Cia. Bras. de Distribuição	PCAR4	Minority stockholder sell stocks	Negative
9	05/13/2013	10:01	HRT	HRTP3	Founder leaves the presidency	Negative
10	05/27/2013	10:02	Santander	SANB3	Sale of participation	Negative
11	07/03/2013	15:03	Eletropaulo	ELPL3	Increase of tariffs	Positive
12	07/08/2013	10:00	CPFL	CPFE3	Association agreement	Positive
13	07/11/2013	11:18	CPFL	CPFE3	Cancellation of investments	Negative
14	08/04/2013	16:27	Gol	GOLL4	Sale of equity	Negative
15	08/05/2013	10:36	Odontoprev	ODPV3	Regulatory authority aproves association	Positive
16	08/26/2013	10:03	Gafisa	GFSA3	Minority stockholder sell stocks	Negative
17	09/06/2013	10:28	OGX	OGXP3	Controller shareholder increases equity	Positive
18	09/10/2013	10:01	MMX	MMXM3	Association agreement	Positive
19	09/18/2013	12:05	Cia. Vale do Rio Doce	VALE4	Sale of participation	Negative
20	10/10/2013	11:39	ALL	ALLL4	Judicial litigation	Negative
21	10/15/2013	11:52	Odontoprev	ODPV3	Founder leaves the presidency	Negative
22	10/18/2013	16:06	Cia. Bras. de Distribuição	PCAR4	Equity issuance	Positive
23	10/31/2013	12:11	OGX	OGXP3	Judicial reorganization	Negative
24	11/11/2013	13:40	Cia. Vale do Rio Doce	VALE4	Sale of shares to reduce exposure to non-strategic assets	Positive
25	11/14/2013	10:00	Cia. Vale do Rio Doce	VALE4	Sale of shares to reduce exposure to non-strategic assets	Positive
26	12/10/2013	14:51	Klabin	KLBN4	Repurchase of stocks due to cash liquidity	Positive
27	12/20/2013	14:16	Cia. Vale do Rio Doce	VALE4	Sale of shares to reduce exposure to non-strategic assets	Positive
28	12/26/2013	11:48	Cia. Vale do Rio Doce	VALE4	Sale of shares to reduce exposure to non-strategic assets	Positive
29	12/27/2013	16:00	Cia. Vale do Rio Doce	VALE4	Sale of shares to reduce exposure to non-strategic assets	Positive
30	12/27/2013	10:40	Eletropaulo	ELPL3	Decrease of revenues	Negative
31	01/20/2014	10:58	Estácio Participações	ESTC3	Regulatory authority evaluation	Positive
32	02/13/2014	11:58	Banco do Brasil	BBAS3	Financial forecasts	Positive

Source: CVM

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[2] After-market trading takes place in Brazil daily between 5:00 p.m. and 6:00 p.m. To the extent that regulatory restrictions on stock price fluctuations and traded volumes are imposed by the Brazilian stock exchange during these sessions, our dataset does not include after-market trading data.

Throughout our sample period we were able to identify 1.252 material facts released on CVM's website. Exactly 245 of these were released during the trading time. From this total, 32 material facts met the liquidity condition. Eighteen of them were classified as positive disclosures and the remaining as negative.

It is possible that material facts cannot be classified as positive or negative *per se*, but rather this classification depends on the relation between what happened and what was expected to happen by market participants. Nonetheless, the disclosure of material facts usually does not represent to market participants publications of gradual content, such as public financial statements, but instead communications of events interpretable dichotomically, such as sales of nonstrategic assets, association agreements, decisions of regulatory authorities, signing of concession contracts and cancellation of bonds' issuance. Some material news, like the results of Initial Public Offers (IPOs) and changes in financial forecasts, indeed required evaluations on what was expected before disclosures. For these latter cases, our evaluation of prior expectations relied on a wide set of press releases.

For each minute with effective trading we collected the following specific data: (i) stock price at which the transaction occurred, (ii) the value of the stock market index Ibovespa at that minute and (iii) the daily accumulated trading volume up to the minute. In the minutes without trading we do not record price or trading volume. Stock prices and stock market index were used to calculate percentage returns per transaction, $(P_{tr}/P_{tr-1}) - 1$, where *tr* represents the transaction.

For statistical tests, abnormal returns between transactions for each single firm were calculated as the difference between observed returns and expected returns. Initially, expected returns were computed through a market model whose coefficients were estimated using Ordinary Least Squares (OLS). For estimations, we considered a three-month period ending ten days before each release.

Formally:

$$AR_{i,t} = R_{i,t} - E(R_{i,t}) = R_{i,t} - (\hat{\alpha} + \hat{\beta} R_{m,t}) \qquad (1)$$

In equation (1), $AR_{i,t}$ and $R_{i,t}$ represent, respectively, the abnormal and observed returns of stock *i* in transaction *t*, while $R_{m,t}$ is the return of the Ibovespa index, whose theoretical portfolio is composed of stocks that accounted for 80% of the volume traded during the last 12 months in BM&FBOVESPA. Additionally, expected returns were

calculated through the Capital Asset Pricing Model (CAPM), using the Brazilian interbank lending market interest rate (the SELIC rate) as the risk-free rate and the Ibovespa index as the market rate. This means to place a restriction on the constant of the market model. As no meaningful difference between the two models was perceived, the results presented come from the market model since it encompasses a more flexible structure without prior restrictions. For comparisons, the CAPM results are shown in the appendix, along with the cumulative abnormal returns computed from the market model for all examined stocks.

To calculate average abnormal returns per minute (AAR_t) we averaged the abnormal returns computed from equation (1). Standard two-tailed t-tests were applied to test the statistical significance of the observed average abnormal returns per minute, and the corresponding t statistics were calculated as $t(AAR_t) = AAR_t/se(AAR_t)$, where $se(AAR_t)$ represents the estimated standard deviation of the average abnormal returns per minute AAR_t. The standard deviation estimates were computed from the empirical distribution of average abnormal returns, constructed through the bootstrap algorithm proposed by Barclay and Litzenberger (1988). The statistical tests applied by Busse and Green (2002) to the mean intraday price changes also relied on the same bootstrap algorithm.

The empirical distribution of average abnormal returns was constructed as follows. First, for each of the eighteen series of intraday stock returns corresponding to the eighteen positive material facts identified, we randomly drew one abnormal return per transaction from the sample of abnormal returns observed during the 3-month period delimited to estimate the coefficients of the market model[3]. Next, we calculated the average of the eighteen abnormal returns drawn. This procedure was repeated 20.000 times in order to find the empirical distribution of the average abnormal returns per minute for the portfolio of firms that disclosed positive material facts. After that, we compute $se(AAR_t)$. The same procedure was employed in the case of negative material

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[3] These values were extracted from samples including, on average, 22.460 observed abnormal returns, each one with the same probability of being drawn. The number of observations in each sample of returns per transaction depended on the stock's liquidity during the 3-month period we considered to estimate the coefficients. In our analysis, the sample size ranged from 19.234 to 26.005 observations. Consequently, taking into account seven hours of trade daily, the most illiquid (liquid) stock exhibited, on average, 41 (56) minutes of effective trade per hour during this period.

facts. Cumulative average abnormal returns (*CAARs*) were calculated simply using the statistically significant average abnormal returns per minute[4].

Next we will describe the procedures for material facts' disclosures. In Brazil, the CVM legally defined a material fact as any decision taken by the company board or controlling shareholders, or even any fact of political, economic, organizational or technical order potentially able to influence (i) the price of stocks issued by publicly traded firms, or equity derivatives, or (ii) investors' decisions to buy, sell or hold stocks. Overall, typical examples of material facts include mergers or divisions, forecast revisions, regulatory intervention, debt renegotiations, discovery of new resources or technologies, approvals or cancellations of investment projects and changes in accounting practices.

The Brazilian authority imposes the disclosure of material facts in order to reduce insider trading arising from informational asymmetries in stock markets. Procedures for disclosing information are regulated by the CVM's normative instructions. Material facts are recognized on a discretionary basis by companies within the scope of CVM regulation, and, after identified, they must be revealed immediately and simultaneously to all markets wherein stocks are traded. For such releases, a file describing the material fact must be sent by means of an electronic system provided by the CVM. Immediately after sending, each file is displayed at the same time on the webpages of the CVM and BM&FBOVESPA. At this moment, the new information becomes unexpectedly available to all investors, without cost.

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[4] Alternatively, we also performed tests using empirical distributions of returns computed for specific time periods—from 2 minutes up to 120 minutes—instead to test the statistical significance of abnormal returns in each minute around the announcement of news. Proceeding this way, the statistical significance of the accumulated return in the first z minutes was tested using the empirical distribution of accumulated returns for z exact minutes. However, the statistically significant abnormal returns observed in the first minutes following disclosures were so high (or low) that they exerted large effects on the statistical significance of almost all subsequent cumulative returns that included them.

To avoid excessive price volatility, normative rules state files should be sent after the trading time or before it. Yet, there are no legal impediments or fines for disclosures during the trading time[5].

Importantly, disclosures trough CVM's system must precede or be simultaneous to those made through any other communication channels, including Twitter messages, firms' webpages and meetings of professional associations, journalists, investors and financial market analysts, as well as other audiences, at home and abroad. Material facts whose revelation could threaten a firm's reasonable interest are exempt from disclosures. This represents the only exception for firms to preserve private information. Even in these cases, however, facts must be communicated to the regulator.

In Brazil, software permanently accessing the websites of the CVM and BM&FBOVESPA are normally used to release material facts to news agencies immediately after disclosures on those sites. This suggests CVM's website is a primary source of information on material facts.

4. Results

4.1—Abnormal Returns Surrounding Disclosures

Following this methodology we found some interesting results concerning market efficiency in Brazil. The average abnormal returns per minute between thirty minutes before releases and sixty minutes after, jointly with *p*-values of a two-tailed *t*-test, are presented in Table II.

Following Drienko and Sault (2013), we expunged penny stocks from our initial sample to avoid distortions in price reactions. We identified two material facts related to penny stocks. In the first one, OGXP3 was traded at R$0.50 (June 2013), whereas in the second, the price of the same stock had plunged to R$0.08 (October 2013). As the bid–ask spreads in both situations were scaled in cents of the local currency, any trade,

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[5] Publicly traded companies were also required, until February 2014, to publish material facts in the newspapers commonly used to release financial statements. The development of the Internet as a communication channel led the CVM to issue normative instruction n. 547 in March 2014, exempting publicly traded companies from this obligation. The newest procedures were created to speed up material facts disclosures, to enable higher dissemination of the news and to decrease the regulatory costs for publicly traded companies. As a matter of fact, at the time the normative draft was being written, discussions on firms' obligations to publish material facts in newspapers also suggested they were the last channel used by companies to disclose new information. The cost reduction aimed to develop the Brazilian stock market as an alternative source of funding for firms. Publications on the CVM and BM&FBOVESPA websites, however, remain mandatory.

driven or not by the disclosures of material facts, would imply high abnormal returns, merely due to the low prices observed[6].

Table II - Average Abnormal Returns: -30 to 60 minutes

	Positive Material Facts		Negative Material Facts			Positive Material Facts		Negative Material Facts	
Minutes	Abnormal Return	p-value	Abnormal Return	p-value	Minutes	Abnormal Return	p-value	Abnormal Return	p-value
-30	-0,00010	0,744	-0,00064	0,300	16	-0,00019	0,658	0,00035	0,475
-29	0,00021	0,492	-0,00040	0,519	17	-0,00008	0,855	-0,00054	0,269
-28	0,00017	0,587	0,00044	0,476	18	0,00012	0,782	0,00029	0,552
-27	0,00005	0,863	0,00030	0,629	19	-0,00005	0,901	-0,00080	0,105
-26	0,00010	0,753	-0,00032	0,604	20	0,00009	0,832	0,00007	0,879
-25	-0,00051 *	0,100	-0,00070	0,262	21	0,00018	0,679	0,00005	0,923
-24	0,00006	0,841	-0,00019	0,762	22	-0,00033	0,439	-0,00040	0,415
-23	-0,00033	0,283	0,00092	0,140	23	0,00066	0,123	-0,00023	0,640
-22	0,00096 ***	0,002	0,00079	0,200	24	-0,00007	0,867	0,00018	0,713
-21	-0,00050	0,104	-0,00039	0,533	25	0,00025	0,561	-0,00022	0,650
-20	-0,00037	0,238	-0,00049	0,431	26	0,00026	0,553	-0,00056	0,250
-19	0,00007	0,834	-0,00034	0,581	27	0,00047	0,278	-0,00006	0,908
-18	0,00025	0,412	0,00083	0,180	28	-0,00042	0,333	-0,00022	0,656
-17	-0,00059 *	0,055	-0,00074	0,235	29	0,00020	0,639	-0,00040	0,417
-16	0,00047	0,132	-0,00012	0,848	30	-0,00008	0,852	0,00007	0,880
-15	-0,00028	0,373	0,00041	0,513	31	-0,00040	0,351	-0,00022	0,658
-14	0,00027	0,387	0,00092	0,137	32	0,00101 **	0,019	0,00078	0,113
-13	-0,00001	0,975	0,00050	0,419	33	0,00000	0,998	-0,00042	0,390
-12	0,00033	0,285	0,00031	0,612	34	-0,00046	0,280	-0,00012	0,805
-11	-0,00044	0,154	0,00019	0,753	35	-0,00022	0,608	-0,00034	0,482
-10	0,00103 ***	0,001	-0,00010	0,868	36	0,00038	0,417	-0,00021	0,673
-9	0,00013	0,669	-0,00002	0,970	37	0,00017	0,721	0,00004	0,937
-8	0,00015	0,617	-0,00035	0,576	38	0,00010	0,831	-0,00007	0,887
-7	-0,00001	0,967	0,00008	0,893	39	-0,00041	0,384	0,00056	0,255
-6	0,00028	0,374	-0,00037	0,551	40	0,00020	0,672	0,00014	0,777
-5	-0,00001	0,973	0,00030	0,631	41	0,00000	0,992	0,00028	0,571
-4	-0,00014	0,656	0,00019	0,758	42	0,00014	0,769	-0,00022	0,656
-3	-0,00005	0,862	-0,00022	0,728	43	-0,00009	0,854	-0,00018	0,710
-2	0,00004	0,887	0,00022	0,723	44	-0,00014	0,772	0,00002	0,963
-1	-0,00015	0,636	-0,00020	0,752	45	-0,00054	0,254	0,00030	0,540
0	0,00035	0,258	-0,00077	0,177	46	0,00028	0,554	-0,00019	0,692
1	-0,00047	0,274	-0,00056	0,249	47	0,00032	0,501	-0,00052	0,290
2	0,00076 *	0,078	0,00083 *	0,091	48	-0,00021	0,656	-0,00165 ***	0,001
3	0,00037	0,390	-0,00033	0,504	49	0,00017	0,712	0,00089 *	0,068
4	0,00004	0,923	0,00002	0,960	50	0,00001	0,991	0,00012	0,803
5	0,00004	0,933	-0,00159 ***	0,001	51	0,00015	0,748	-0,00084 *	0,087
6	0,00003	0,941	0,00149 ***	0,002	52	0,00000	0,995	-0,00021	0,662
7	-0,00005	0,908	0,00028	0,569	53	0,00000	0,998	0,00003	0,947
8	0,00049	0,250	0,00016	0,743	54	0,00000	0,994	-0,00022	0,649
9	0,00012	0,775	0,00064	0,188	55	0,00064	0,209	0,00050	0,306
10	-0,00025	0,557	-0,00003	0,951	56	-0,00058	0,255	0,00007	0,882
11	-0,00009	0,843	-0,00075	0,127	57	-0,00012	0,810	0,00030	0,543
12	0,00013	0,769	-0,00105 **	0,033	58	-0,00097 *	0,056	-0,00059	0,229
13	-0,00006	0,886	0,00052	0,293	59	0,00041	0,417	0,00025	0,628
14	0,00020	0,644	-0,00058	0,241	60	-0,00029	0,572	-0,00058	0,259
15	-0,00082 *	0,056	0,00011	0,830					

Table II presents average abnormal returns in the minutes relative to the disclosure of positive and negative material facts, respectively. The stars ***, ** and * indicate significance at one, five and ten percent levels, respectively. Statistically significant average abnormal returns were used to construct the solid lines in Charts 1 and 2. For returns in percent terms, values must be multiplied by 100.

Charts 1 and 2 show the cumulative abnormal returns, without penny stocks, in the minutes close to releases of positive and negative material facts, respectively. Dotted

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[6] Inclusion of the OGXP3 increased the magnitudes of abnormal returns, as expected, but not the patterns of cumulative average returns. Results are available by request.

lines were graphed using the observed abnormal returns, while the solid ones were constructed using only the statistically significant abnormal returns from Table II.

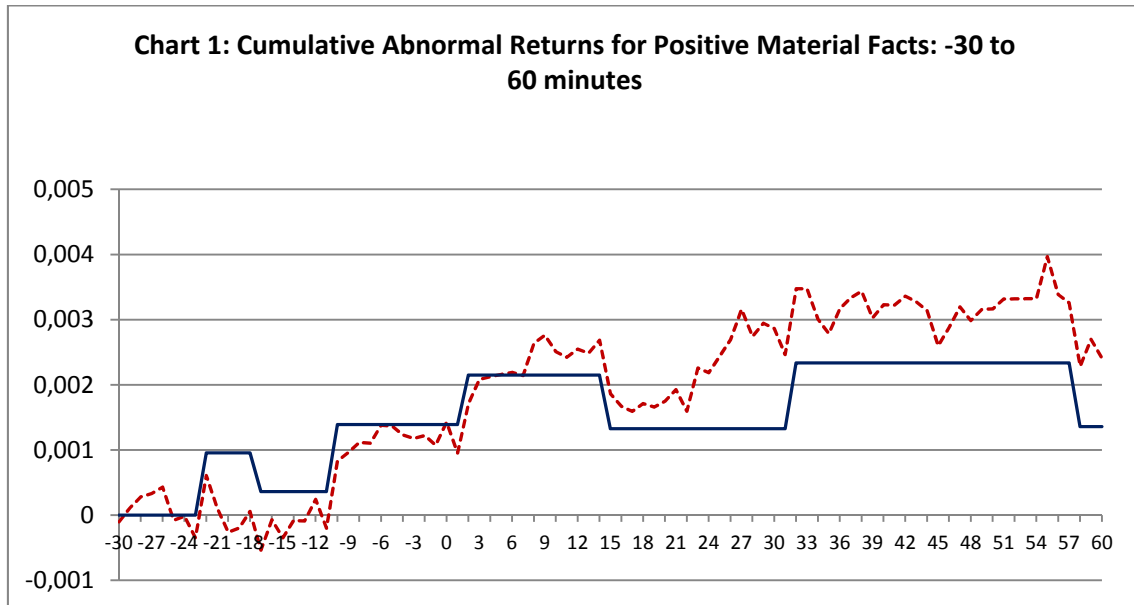**Chart 1: Cumulative Abnormal Returns for Positive Material Facts: -30 to 60 minutes**

Chart 1 shows the cumulative abnormal returns for the equally weighted portfolio of firms with positive news in the minutes surrounding releases. The dotted line represents observed cumulative returns, whereas the solid one was constructed using only statistically significant abnormal returns from a two-tailed *t*-test, presented in Table II.

Chart 2: Cumulative Abnormal Returns for Negative Material Facts: -30 to 60 minutes
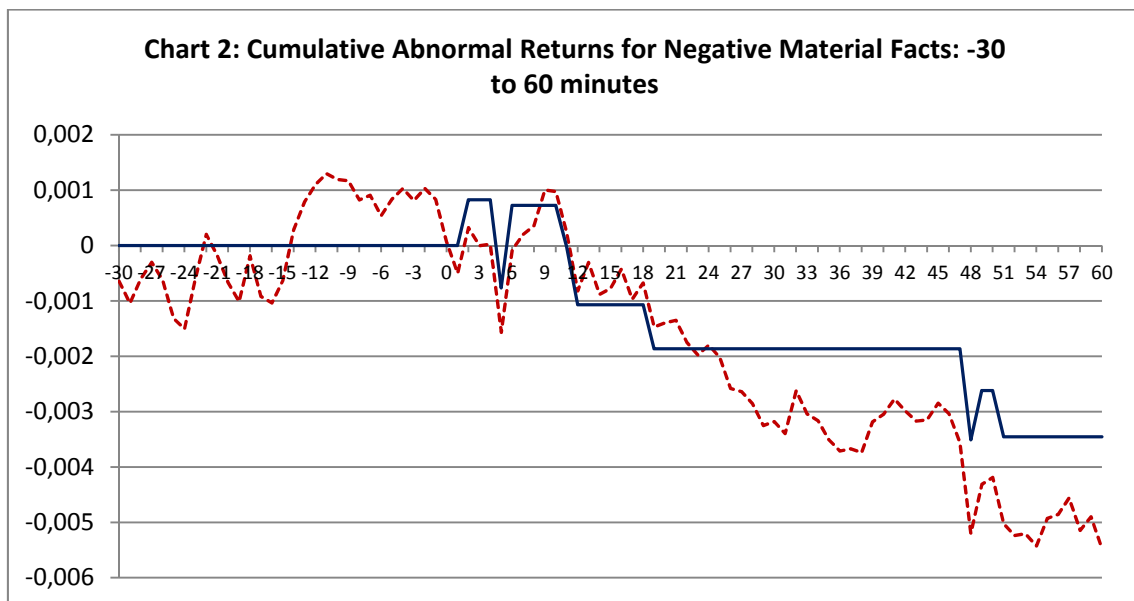
Chart 2 shows cumulative abnormal returns for the equally weighted portfolio firms with negative news in the minutes surrounding releases. The dotted line represents observed cumulative returns, whereas the solid one was constructed using only statistically significant abnormal returns in a two-tailed *t*-test, presented in Table II.

Charts show material facts reported by publicly traded firms on the CVM's website indeed seem to contain new and unexpected information on the stock market. Stock prices react positively for good releases and negatively for bad releases, as shown by the paths of *CAARs* in the minutes around the firm-specific announcements. As

reported in prior studies on market efficiency, our findings indicate price adjustments to market news are not instantaneous. After good and bad news, graphs above show stock prices take about thirty and fifty minutes to estabilize, respectively, with an earlier stabilization for the good news portfolio. This last result is consistent with the higher costs associated with short selling operations. Furthermore, during the whole period, stock returns changed substantially, without evidence of overreaction in stock prices. Considering the statistically significant returns, cumulative returns for positive (negative) news changed from zero to 0.23% (-0.35%). The magnitudes of stock price reactions and the speed of price response reveal profit opportunities for those market participants who trade in the minutes close to the release of material facts in Brazil. Additionally, given that our sample comprised only liquid stocks traded in BM&FBOVESPA, perhaps our results hint at the lowest time needed for stock prices to completely incorporate new information in Brazil.

Actually, while stock returns started reacting to bad news just after releases, cumulative returns for the portfolio of firms with good news started to rise about twenty-four minutes prior to disclosures, suggesting anticipated trading activity. Adding up average returns before positive facts, we found 0.14%. Thus, for positive material news, it seems that some price adjustments took place before the announcements. On this issue, we should stress the possibility of firms disclosing material facts just after unusual price reactions or trading activity, following CVM's specific recommendations precisely stated to avoid insider trading. In this case, we could be observing firms' announcements reacting to prices, instead of the opposite. Nevertheless, this type of reversal causality does not change our conclusions hinting at insider trading.

Aiming to ensure robustness to the results we found using the market model and the CAPM, we used a control group as an alternative benchmark to calculate abnormal returns. The control firms belong to the same industry of the treated firms, i.e., those whose material facts were disclosed during the trading time. A robustness test of this type is important since industry-specific shocks may increase the differences between observed returns and expected returns calculated from market-based models. Matching for industry was employed by Busse and Green (2002), Hendricks and Singhal (2001) and Womack (1996) to control industry-specific effects on stock returns. In selecting companies for the control group we relied on a classification by industry prepared by the BMF&BOVESPA, available on the institution's website and developed to provide a

clearer view of the areas of activity of the listed companies to investors. This classification was built considering mainly the types and uses of the products and services developed by listed companies. Following this grouping by industry, we identified for each company in our sample a set of firms that (i) belong to the same industry and (ii) meet the liquidity criterion previously set[7]. Abnormal returns from this approach were computed as follows:

$$AR_{i,t} = R_{i,t} - R_{c\_i,t} \tag{2}$$

In equation (2), $AR_{i,t}$ and $R_{i,t}$ represent, respectively, abnormal and observed returns of stock i in transaction t, while $R_{c\_i,t}$ is the return in transaction t of an equally weighted portfolio of firms from the same industry as firm i. In the case where we could not identify firms that met the liquidity criterion, $R_{c\_i,t}$ was replaced by $R_{m,t}$, the return of the Ibovespa index. After having calculated the abnormal returns for each company, we computed the average returns for the companies that reported positive material facts $(\overline{R_{i,t}})$ and for the corresponding control firms $(\overline{R_{c\_i,t}})$. After that, we applied *t*-tests to identify statistically significant differences between the averages $\overline{R_{i,t}}$ and $\overline{R_{c\_i,t}}$, i.e., statistically significant average abnormal returns. Standard deviation estimates of this difference were computed from the empirical distributions of $\overline{R_{i,t}}$ and $\overline{R_{c\_i,t}}$. The bootstrap method set previously was applied to construct the empirical distributions. We applied the same procedure for negative material facts. Table III shows average abnormal returns from -30 to 60 minutes and *p*-values of a two-tailed *t*-test for both positive and negative material facts.

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[7] We identified controls for the following companies: Eletropaulo (Cemig, Cesp, Copel, CPFL, Light, and Tractebel), Anhanguera (Kroton and Estacio Participações), Banco do Brasil (Banrisul, Bradesco, Itaú, and Santander), Brookfield (Even, Eztec, MRV, JHSF, PDG, Rossi, Tecnisa, Direcional, Cyrella, and Gafisa), Gafisa (Even, Eztec, MRV, JHSF, PDG, Rossi, Tecnisa, Direcional, Cyrella, and Brookfield), CPFL (Cemig, Cesp, Copel, Eletropaulo, Light, and Tractebel), Odontoprev (Qualicorp), Santander (Banco do Brasil, Banrisul, Bradesco, and Itaú), MMX (Vale do Rio Doce), HRT (Petrobras), Ecorodovias (CCR), and Vale do Rio Doce (MMX). For the remaining companies we used the Ibovespa index.

Table III - Average Abnormal Returns: -30 to 60 minutes

	Positive Material Facts		Negative Material Facts			Positive Material Facts		Negative Material Facts	
Minutes	Abnormal Return	p-value	Abnormal Return	p-value	Minutes	Abnormal Return	p-value	Abnormal Return	p-value
-30	-0,00034	0,385	-0,00051	0,547	16	-0,00042	0,401	0,00027	0,646
-29	0,00042	0,280	-0,00039	0,646	17	-0,00072	0,149	-0,00053	0,359
-28	-0,00005	0,896	0,00007	0,938	18	0,00027	0,593	0,00028	0,630
-27	-0,00003	0,942	0,00034	0,683	19	-0,00006	0,897	-0,00073	0,207
-26	0,00039	0,318	-0,00024	0,778	20	0,00010	0,834	0,00019	0,741
-25	-0,00011	0,785	-0,00075	0,374	21	0,00008	0,870	0,00016	0,781
-24	-0,00055	0,161	0,00017	0,841	22	0,00016	0,753	-0,00045	0,435
-23	-0,00032	0,412	0,00071	0,396	23	0,00054	0,283	0,00001	0,979
-22	0,00127 ***	0,001	0,00116	0,166	24	0,00016	0,754	0,00016	0,784
-21	-0,00033	0,404	-0,00036	0,671	25	0,00009	0,860	0,00009	0,873
-20	-0,00044	0,263	-0,00058	0,494	26	0,00041	0,410	-0,00105 *	0,070
-19	-0,00003	0,930	-0,00048	0,569	27	0,00051	0,308	-0,00011	0,856
-18	-0,00002	0,965	0,00072	0,390	28	-0,00082	0,102	-0,00022	0,701
-17	-0,00065 *	0,094	-0,00055	0,516	29	-0,00002	0,962	-0,00058	0,320
-16	0,00052	0,180	0,00024	0,778	30	0,00001	0,988	0,00004	0,945
-15	-0,00041	0,298	0,00018	0,833	31	-0,00038	0,444	-0,00045	0,441
-14	0,00028	0,472	0,00087	0,298	32	0,00043	0,388	0,00069	0,234
-13	-0,00002	0,950	0,00032	0,702	33	0,00102 **	0,041	-0,00044	0,452
-12	0,00049	0,211	0,00039	0,642	34	-0,00023	0,646	-0,00010	0,860
-11	-0,00034	0,382	0,00010	0,907	35	-0,00037	0,457	-0,00022	0,709
-10	0,00107 ***	0,006	-0,00006	0,946	36	0,00037	0,464	-0,00009	0,877
-9	-0,00053	0,178	-0,00005	0,951	37	0,00003	0,952	0,00009	0,883
-8	0,00002	0,963	-0,00034	0,683	38	0,00038	0,477	-0,00023	0,691
-7	0,00030	0,444	0,00016	0,854	39	-0,00066	0,214	0,00075	0,199
-6	0,00050	0,202	-0,00057	0,494	40	0,00026	0,624	-0,00001	0,990
-5	0,00009	0,823	0,00014	0,870	41	-0,00028	0,592	0,00036	0,538
-4	0,00021	0,585	0,00017	0,843	42	0,00035	0,506	-0,00030	0,609
-3	0,00050	0,201	-0,00001	0,989	43	-0,00045	0,397	-0,00037	0,525
-2	-0,00043	0,271	0,00008	0,927	44	0,00000	1,000	-0,00007	0,900
-1	-0,00010	0,798	-0,00061	0,465	45	-0,00015	0,779	-0,00019	0,739
0	-0,00032	0,406	-0,00089	0,288	46	-0,00042	0,430	-0,00025	0,660
1	-0,00011	0,833	-0,00069	0,235	47	-0,00027	0,606	-0,00090	0,119
2	0,00017	0,740	0,00069	0,232	48	0,00046	0,386	-0,00122 **	0,036
3	0,00018	0,715	-0,00047	0,419	49	-0,00037	0,489	0,00087	0,132
4	0,00031	0,530	0,00030	0,606	50	0,00037	0,481	0,00027	0,647
5	-0,00025	0,622	-0,00116 **	0,046	51	-0,00013	0,807	-0,00047	0,419
6	0,00002	0,967	0,00168 ***	0,004	52	-0,00066	0,212	-0,00028	0,635
7	-0,00071	0,158	0,00035	0,548	53	-0,00032	0,502	-0,00010	0,868
8	0,00049	0,323	0,00016	0,782	54	0,00007	0,882	-0,00040	0,490
9	0,00045	0,373	0,00054	0,350	55	0,00070	0,136	0,00070	0,227
10	-0,00059	0,240	0,00034	0,559	56	0,00007	0,885	0,00030	0,607
11	0,00026	0,602	-0,00058	0,318	57	-0,00060	0,199	0,00006	0,919
12	-0,00016	0,742	-0,00102 *	0,079	58	-0,00097 **	0,039	-0,00076	0,190
13	0,00006	0,903	0,00073	0,208	59	0,00023	0,618	0,00061	0,294
14	-0,00010	0,834	-0,00030	0,606	60	-0,00004	0,932	-0,00046	0,432
15	-0,00071	0,156	-0,00021	0,723					

Table III presents average abnormal returns in the minutes relative to the disclosure of positive or negative material facts, respectively. The stars ***, ** and * indicate significance at one, five and ten percent levels, respectively. Statistically significant average abnormal returns were used to construct the solid lines in Charts 3 and 4. For returns in percent terms, values must be multiplied by 100.

The results found using the control group as a benchmark were quite similar to those found using the market model. In Chart 3 the dashed lines show the cumulative returns per transaction for the control group and the equally weighted portfolio of firms impacted by positive news. As shown in Chart 1, it seems the good news took about thirty minutes to be fully reflected into stock prices.

Chart 3: Cumulative Abnormal Returns for Positive Material Facts: -30 to 60 minutes
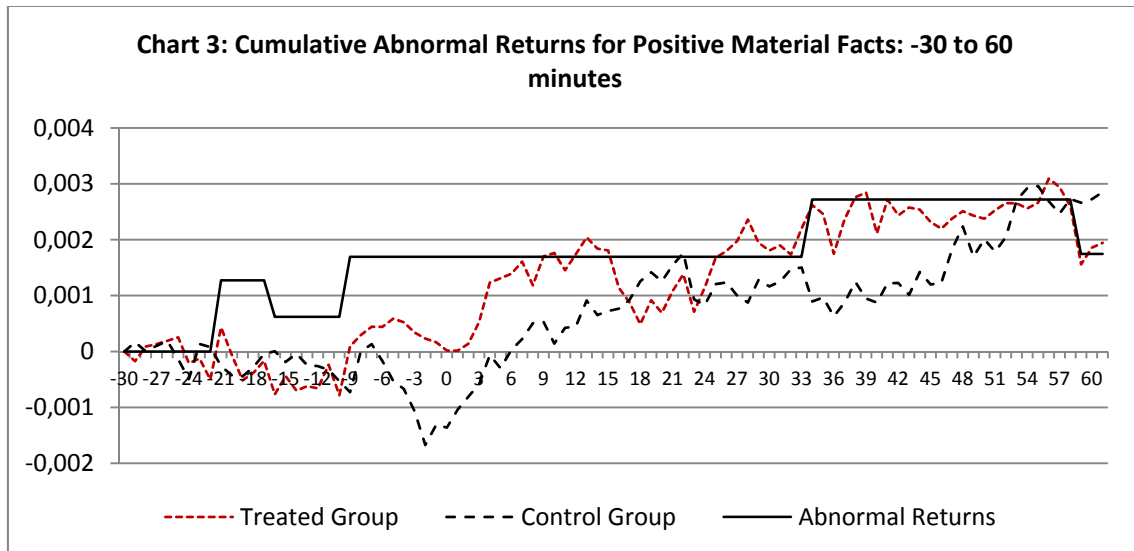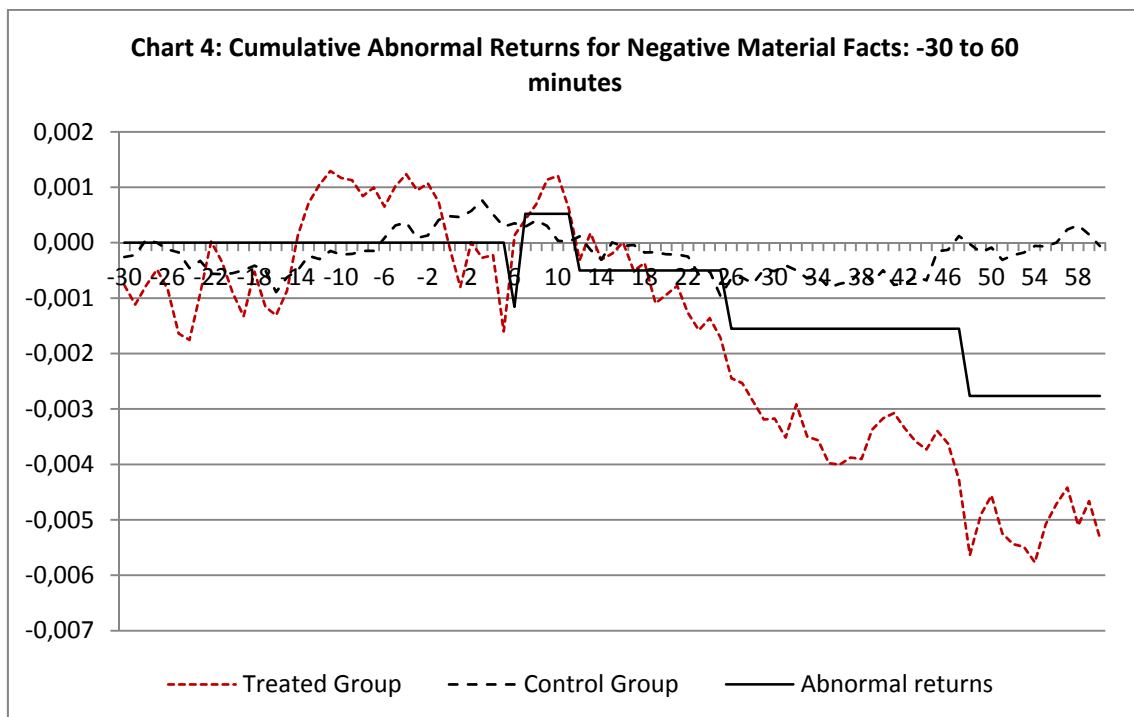
Chart 3 shows cumulative returns for the control group and the equally weighted portfolio of firms with positive news in the minutes surrounding releases. The dotted line represents observed cumulative returns, whereas the solid one was constructed using only statistically significant abnormal returns in a two-tailed *t*-test.

Chart 4 shows the same results for firms that released negative material facts:

Chart 4: Cumulative Abnormal Returns for Negative Material Facts: -30 to 60 minutes

Chart 4 shows cumulative returns for the control group and the equally weighted portfolio of firms with negative news in the minutes surrounding releases. The dotted line represents observed cumulative returns, whereas the solid one was constructed using only statistically significant abnormal returns in a two-tailed *t*-test.

Such cumulative returns were calculated from the price changes of the stocks comprising each portfolio throughout the period. We should point out that the returns of the treated firms in the minutes close to the release of material facts were quite notable.

The solid line in the diagrams was constructed using the statistically significant abnormal returns indicated in Table III.

Busse and Green (2002) reported that cumulative returns stabilized at -1.25% and 0.50%, after the Morning Call negative mentions and Midday Call positive news, respectively. Although our findings indicate profit opportunities, our rates are considerably smaller. One possible explanation for this result is that firms in Brazil usually only disclose information not supposed to cause excessive volatility in prices during the trading time.

Recently, event studies employing intraday data have shown that prices adjust quickly to new information. Kim et al. (2007) provides evidence stock prices in the US stock market take five to fifteen minutes to fully reflect the information contained in buying recommendations pre-released by analysts before the market opens, arguing competition among traders causes information to be fully reflected into stock prices. Similarly, Busse and Green (2002) results pointed out stock prices in the US market take up to thirteen minutes to impound the new information. Consistent with the results reported by Drienko and Sault (2013), our findings indicate new information is incorporated into stock prices within fifty minutes. Yet, this time is longer than that observed by Kim et al. (1997) and Busse and Green (2002), as expected given the size and the trading volume in the US stock market. However, it is important to highlight our conclusions remain aligned with those found in the studies on market efficiency, in the sense that markets are efficient but offer short-term profit opportunities for those who follow them more closely.

4.2—Number of Shares Traded

Concerning the traded volume, we performed the Wilcoxon test for medians to test whether the median number of shares traded in the minutes immediately after and before releases of material facts were higher than the observed medians in other trading minutes. For positive material facts, stars in Table IV denote that the median number of shares traded in the minute indicated by the column is statistically higher than the median number of shares traded in the minute specified by the row.

Wilcoxon tests for positive news revealed that the medians calculated for the fourth minute before and for the first minute after disclosures are higher than the medians computed for a number of minutes before the announcements. The number of

shares traded increased in the first minute after the release of positive news, indicating that market participants indeed seek to exploit profit opportunities. To the extent that the median number of shares traded also grew four minutes before the disclosure of good news, the results again hint at some anticipated trading activity.

Table IV - Wilcoxon test for the number of shares traded in the minutes surrounding disclosures of positive news

	-5 to -10	-4	-3	-2	-1	0	1	2-10
0 to -5								
-6								
-7		5200 (1,82)**					4300 (2,09)**	
-8							4300 (1,65)**	
-9								
-10							4300 (2,09)**	
-11								
-12								
-13								
-14								
-15		5200 (1,89)**				4600 (1,68)**	4300 (2,36)***	
-16								
-17							4300 (1,94)**	
-18		5200 (1,66)**					4300 (1,67)**	
-19		5200 (1,92)**						
-20		5200 (1,76)**					4300 (2,21)**	

Table IV presents the median number of traded shares in the minutes relative to the disclosure of positive news. Wilcoxon statistics are shown in parentheses. Two and three stars mean the median number of shares traded in the minute indicated by the column is statistically higher than the median number of shares traded in the minute specified by the row, at five and one percent levels, respectively. Tests were performed from -10 to 10 minutes relative to disclosures.

Table V shows the results of the Wilcoxon's test for negative material facts. Compared to the case of positive news, we found weaker evidence of changes in the number of shares traded. Nonetheless, we detected increases in the amounts traded, at a significance level of 5%, in the ninth minute following the disclosure of negative news. The high number of shares traded was associated with decreases in stock returns.

Table V - Wilcoxon test for the number of shares traded in the minutes surrounding disclosures of negative news

	-2 to -10	0	5	6	7	8	9	10
0 to -5								
-6								
-7				4100 (1,33)*			8000 (1,41)*	
-8							8000 (1,39)*	
-9		4500 (1,28)*		4100 (1,46)*			8000 (1,80)**	
-10								
-11								
-12								
-13							8000 (1,66)**	
-14								
-15 to -20								

Table V presents the median number of traded shares in the minutes relative to the disclosure of positive news. Wilcoxon statistics are shown in parentheses. Two and three stars mean the median number of shares traded in the minute indicated by the column is statistically higher than the median number of shares traded in the minute specified by the row, at five and one percent levels, respectively. Tests were performed from -10 to 10 minutes relative to disclosures.

5. Conclusion

In this paper we used intraday stock returns and compulsory releases of material facts by publicly traded companies to assess market efficiency in Brazil. Our event study coupled a high-frequency database on transaction prices and traded volume with a set of material facts provided by the regulatory authority of security markets in Brazil in order to evaluate how fast stock prices fully reflect all information made publicly available. We believe the main contribution of this paper is to produce some evidence on market efficiency in Brazil using intraday data on stock prices, traded shares, and the releasing of material facts.

According to our results, material facts reported by publicly traded firms indeed seem to reveal new and unexpected information to the stock market. Price adjustments to news are not instantaneous, as reported in prior event studies using intraday data. Our results pointed out stock prices in Brazil take up to fifty minutes to incorporate the news.

During the entire period of price adjustments, stock returns changed substantially. Cumulative returns for positive news changed in approximately 0.23 p.p. from twenty-four minutes before to thirty-three minutes after disclosures. For negative material news, cumulative returns decreased 0.35 p.p. after fifty minutes. The magnitudes of stock price reactions and the speed of price response reveal profit

opportunities for those market participants who trade in the minutes close to the release of material facts in Brazil. Our results are robust for penny stocks. Similar results were also found using a control group of firms as an alternative benchmark.

The number of shares traded increased in the first minute after the release of positive news, and in the ninth minute after the release of negative material news, indicating that market participants indeed react to profit opportunities. Because we observed price reactions prior to the disclosure of material facts and a high median number of shares traded four minutes before the release of good news, our results also hint at some anticipated trading activity.

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Appendix

I - CAPM Results

Table VI - Average Abnormal Returns: -30 to 60 minutes - CAPM

	Positive Material Facts		Negative Material Facts			Positive Material Facts		Negative Material Facts	
Minutes	Abnormal Return	p-value	Abnormal Return	p-value	Minutes	Abnormal Return	p-value	Abnormal Return	p-value
-30	-0,00017	0,600	-0,00064	0,254	16	-0,00026	0,546	0,00035	0,466
-29	0,00034	0,293	-0,00040	0,479	17	0,00000	0,999	-0,00054	0,264
-28	0,00017	0,592	0,00044	0,429	18	0,00013	0,769	0,00029	0,544
-27	0,00007	0,820	0,00030	0,590	19	-0,00001	0,989	-0,00079 *	0,100
-26	0,00010	0,751	-0,00032	0,570	20	0,00009	0,843	0,00008	0,874
-25	-0,00047	0,146	-0,00069	0,217	21	0,00014	0,756	0,00005	0,918
-24	0,00019	0,557	-0,00018	0,742	22	-0,00040	0,362	-0,00040	0,411
-23	-0,00042	0,191	0,00092	0,102	23	0,00073 *	0,092	-0,00023	0,639
-22	0,00090 ***	0,005	0,00080	0,155	24	-0,00020	0,649	0,00018	0,706
-21	-0,00053 *	0,098	-0,00038	0,493	25	0,00032	0,464	-0,00022	0,649
-20	-0,00047	0,141	-0,00049	0,386	26	0,00033	0,445	-0,00056	0,245
-19	0,00022	0,491	-0,00034	0,545	27	0,00044	0,316	-0,00005	0,910
-18	0,00011	0,742	0,00083	0,137	28	-0,00034	0,439	-0,00022	0,654
-17	-0,00054 *	0,090	-0,00073	0,191	29	0,00025	0,571	-0,00040	0,413
-16	0,00031	0,332	-0,00012	0,836	30	-0,00002	0,957	0,00008	0,875
-15	-0,00024	0,451	0,00041	0,466	31	-0,00040	0,361	-0,00021	0,656
-14	0,00021	0,520	0,00092 *	0,099	32	0,00099 **	0,022	0,00078	0,106
-13	0,00006	0,862	0,00050	0,369	33	-0,00002	0,961	-0,00042	0,386
-12	0,00035	0,280	0,00032	0,572	34	-0,00041	0,348	-0,00012	0,806
-11	-0,00058 *	0,072	0,00020	0,725	35	-0,00020	0,651	-0,00034	0,478
-10	0,00106 ***	0,001	-0,00010	0,858	36	0,00024	0,583	-0,00020	0,672
-9	0,00006	0,862	-0,00002	0,971	37	0,00027	0,530	0,00004	0,932
-8	0,00024	0,458	-0,00034	0,540	38	0,00009	0,831	-0,00007	0,889
-7	-0,00003	0,914	0,00009	0,878	39	-0,00030	0,490	0,00056	0,246
-6	0,00010	0,746	-0,00037	0,513	40	0,00011	0,801	0,00014	0,770
-5	0,00002	0,942	0,00030	0,592	41	0,00003	0,952	0,00028	0,562
-4	-0,00011	0,731	0,00019	0,730	42	0,00010	0,824	-0,00022	0,654
-3	-0,00008	0,810	-0,00021	0,704	43	0,00003	0,945	-0,00018	0,710
-2	-0,00003	0,917	0,00007	0,899	44	-0,00013	0,763	0,00002	0,959
-1	-0,00015	0,630	0,00039	0,488	45	-0,00043	0,318	0,00030	0,532
0	0,00026	0,420	-0,00077	0,153	46	0,00028	0,515	-0,00019	0,691
1	-0,00045	0,302	-0,00056	0,244	47	0,00032	0,460	-0,00052	0,285
2	0,00075 *	0,085	0,00083 *	0,086	48	-0,00042	0,331	-0,00165 ***	0,001
3	0,00034	0,429	-0,00032	0,501	49	0,00036	0,414	0,00090 *	0,063
4	-0,00005	0,915	0,00003	0,956	50	0,00000	0,992	0,00012	0,796
5	0,00011	0,795	-0,00159 ***	0,001	51	0,00015	0,732	-0,00084 *	0,083
6	0,00004	0,919	0,00150 ***	0,002	52	0,00006	0,889	-0,00021	0,660
7	-0,00002	0,966	0,00028	0,561	53	-0,00005	0,927	0,00003	0,942
8	0,00051	0,242	0,00016	0,736	54	0,00000	0,997	-0,00022	0,647
9	0,00015	0,734	0,00065	0,181	55	0,00065	0,184	0,00050	0,297
10	-0,00033	0,450	-0,00003	0,953	56	-0,00050	0,310	0,00007	0,877
11	-0,00010	0,819	-0,00075	0,123	57	-0,00012	0,807	0,00030	0,534
12	0,00011	0,799	-0,00104 **	0,031	58	-0,00106 **	0,031	-0,00059	0,224
13	-0,00010	0,821	0,00052	0,284	59	0,00049	0,320	0,00025	0,604
14	0,00016	0,705	-0,00057	0,236	60	-0,00022	0,656	-0,00057	0,235
15	-0,00075 *	0,084	0,00011	0,824					

Table VI presents average abnormal returns computed from CAPM model in the minutes relative to the disclosure of positive and negative material facts. The stars ***, ** and * indicate significance at one, five and ten percent levels, respectively. Statistically significant average abnormal returns were used to construct the solid lines in Charts 3 and 4. For returns in percent terms, values must be multiplied by 100.
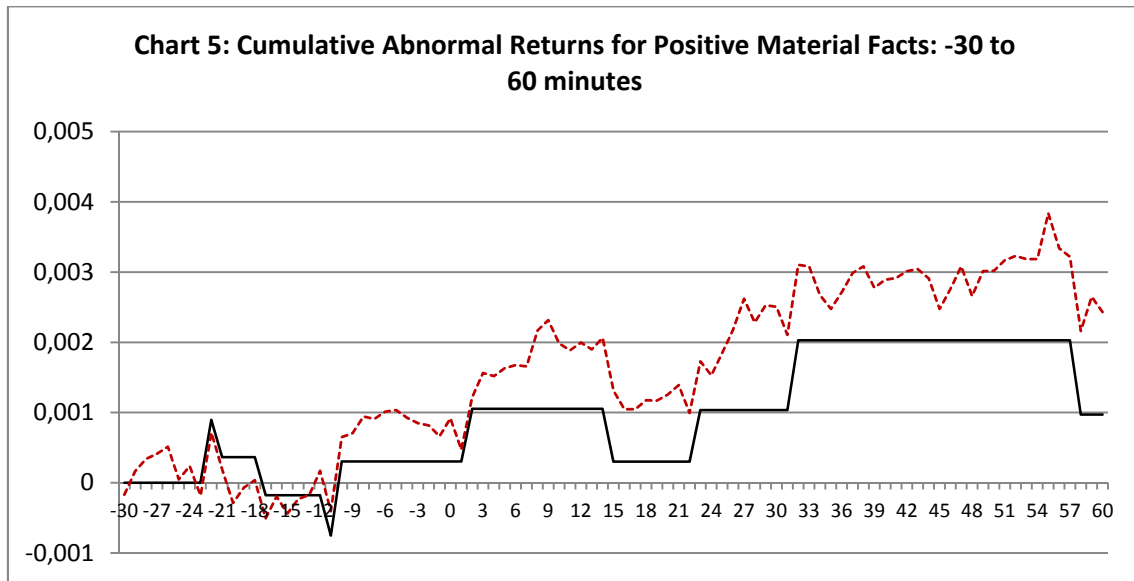
II - CAPM – Cumulative Abnormal Returns

Chart 5 shows cumulative abnormal returns for the equally weighted portfolio of firms with positive news in the minutes surrounding the releases, computed from the CAPM model. The dotted line represents observed cumulative returns whereas the solid one was constructed using only statistically significant abnormal returns in a two-tailed t test, presented in Table IV.
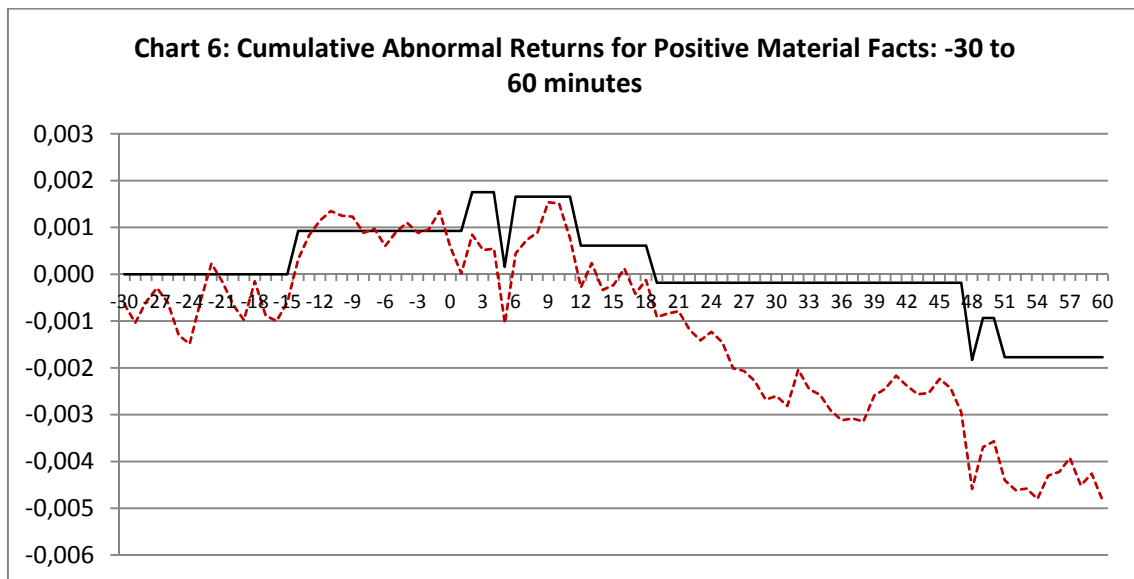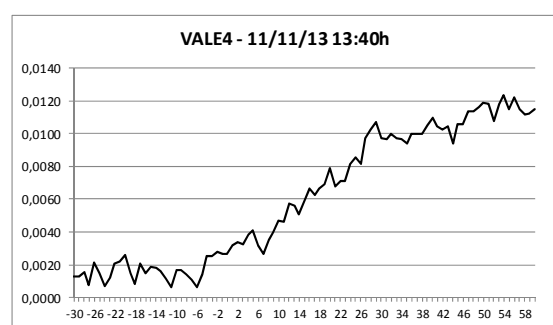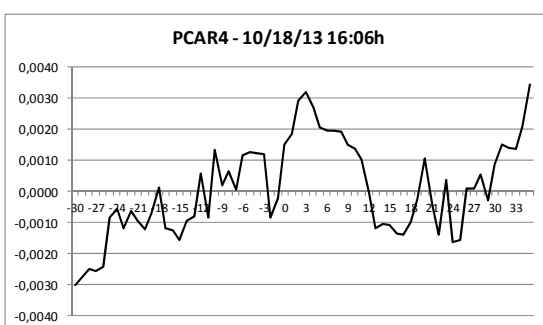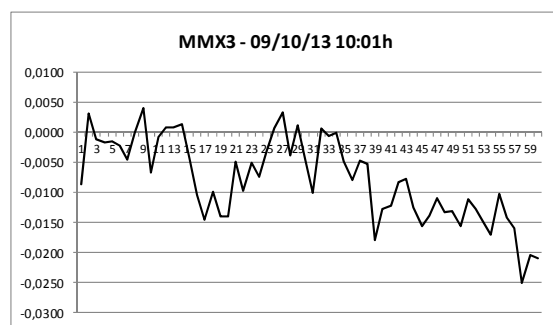

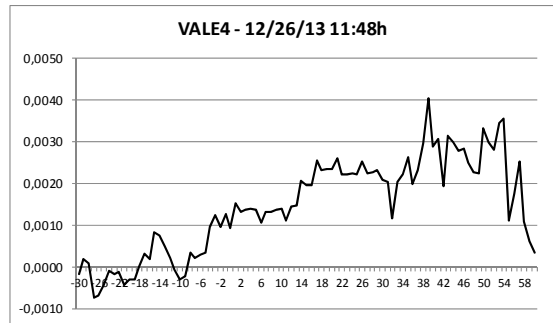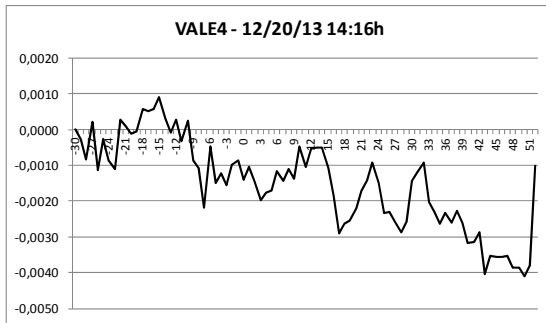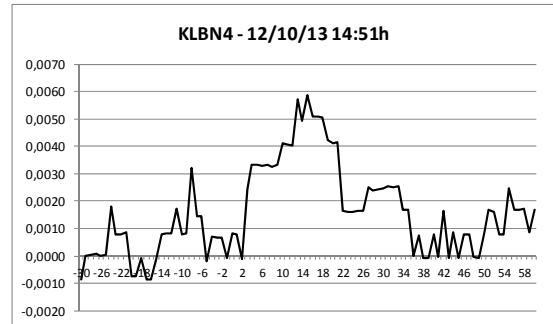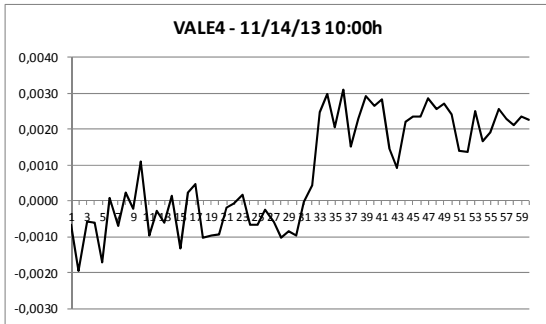Chart 6 shows cumulative abnormal returns for the equally weighted portfolio of firms with negative news in the minutes surrounding the releases, computed from the CAPM model. The dotted line represents observed cumulative returns whereas the solid one was constructed using only statistically significant abnormal returns in a two-tailed t test, presented in Table IV.

III - Market Model – Firms' Abnormal Returns

Positive Material Facts:

VALE4 - 03/11/2013 12:43h

PCAR I - 04/17/13 13:01h

ECOR3 - 04/17/2013 12:47h

AEDU3 - 04/23/13 - 11:01h

ELPL - 07/03/13 15:03h

CPFE - 07/08/13 10:00h

ODPV3 - 08/05/13 10:36h

MMX3 - 09/10/13 10:01h

PCAR4 - 10/18/13 16:06h

VALE4 - 11/11/13 13:40h

VALE4 - 11/14/13 10:00h

KLBN4 - 12/10/13 14:51h

VALE4 - 12/20/13 14:16h

VALE4 - 12/26/13 11:48h

VALE4 - 12/27/13 16:00h

ESTC3 - 01/20/14 10:58h

BBAS3 - 02/03/14 11:58h
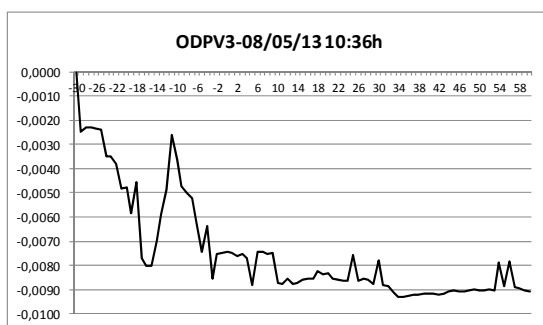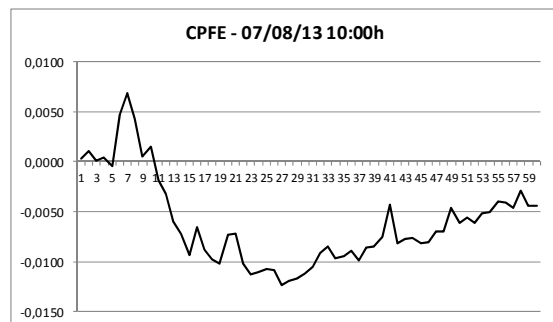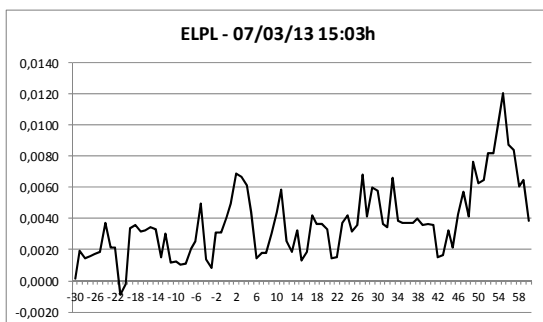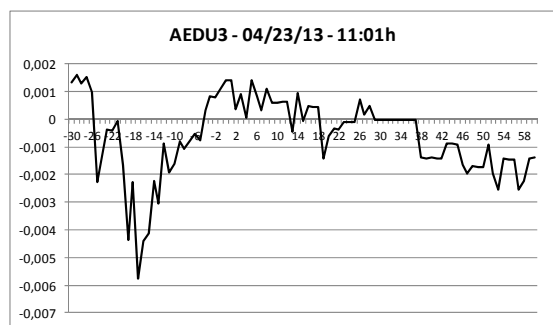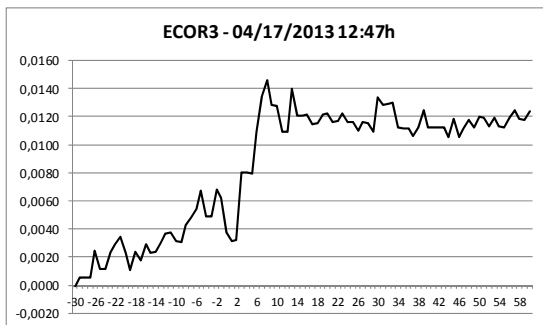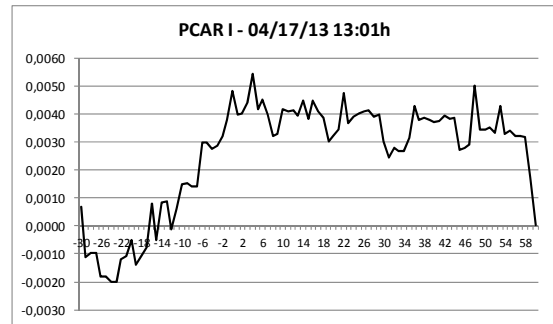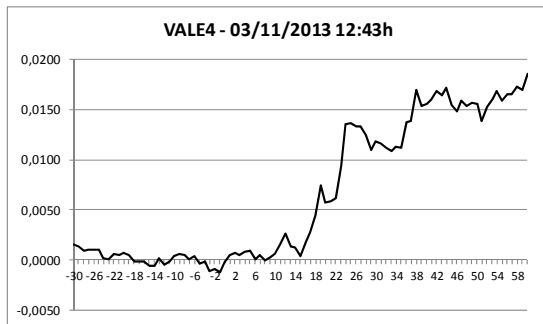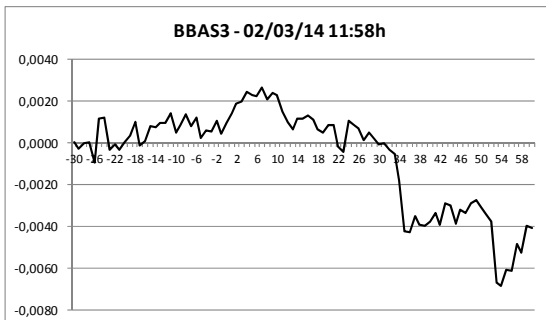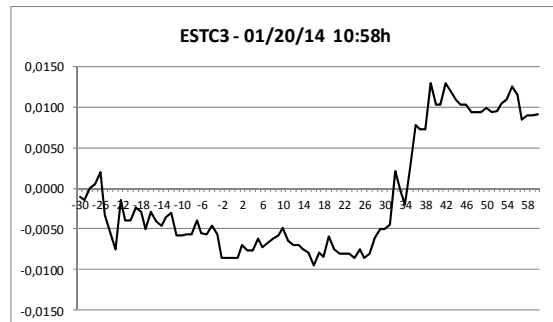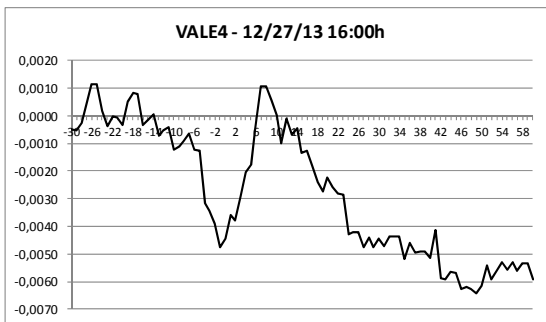
Market Model – Firms' Abnormal Returns

Negative Material Facts:

BISA3 - 02/22/13 15:54h

BBAS3 - 04/16/13 16:16h

GOLL4 - 04/26/13 15:31h

PCAR4 - 05/13/13 12:12h

HRT - 05/13/13 10:01h

Santander - 05/27/13 10:02h

CPFE - 11/07/13 11:18h

GOLL4 - 08/04/13 16:27h

GFSA3 - 08/23/13 10:03h

VALE4 - 09/18/13 12:05h

ALLL4 10/10/13 10:39h

ODPV3 - 10/15/13 11:52h

ELPL3 12/27/13 10:40h