Market Reaction and Volatility in the Brazilian Stock Market[*]

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Abstract

We perform an event study to investigate stock returns associated to the announcement of equity issues by Brazilian firms between 1992 and 2003 aiming to determine the market reaction before, during, and after the issue announcement. After measuring abnormal returns by OLS, we used ARCH and GARCH models over 70% of the sample. The results show signs of insider information, negative abnormal returns around the announcement, and persistent negative abnormal returns in the long-term after the issue. The results are consistent with the extant empirical literature and show that ARCH/GARCH estimation of abnormal returns is superior to OLS estimation.

1. Introduction

The empirical evidence on market reactions to equity issues have inspired researchers to develop theories to explain seemingly abnormal results, thus contributing for a better understanding of capital markets phenomena. Several hypotheses have been proposed to explain market reactions to public equity offerings. These may be grouped into three categories:

(a) There is no price effect – in agreement with the hypotheses of efficient market with shares being considered as close substitute goods;

(b) There are negative price effects – in agreement with informational effects associated to the issuing of overpriced equity by well-informed sellers, to leveraged-related capital structure hypotheses based upon redistribution of firm value among different classes of stockholders, and to downward sloping demand curves for shares; and

(c) There are positive price effects – consistent with favorable information signaled by investment, and with reduction in expected costs of financial distress and agency costs.

This paper examines stock returns related to 80 equity public issues by Brazilian firms listed in the Sao Paulo stock market carried out from 1992 to 2003. More specifically, the paper investigates if the Brazilian market is consistent with the international evidence on the market reaction: (a) within the period from 15 workdays before the

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issue announcement until the announcement day; (b) at the announcement and subsequent days; and (c) throughout the one-year period after the issue.

Initially, the study intends to measure eventual abnormal returns using the usual approach in event studies, i.e. the market model (Mackinlay et al, 1997), where the abnormal returns are the residuals of OLS regressions. However, as empirically evidenced (Bollerslev, 1986; Akgiray, 1989; Chiang e Doong, 2001), it is quite usual that equity returns follow autoregressive processes with conditionally heteroscedastic innovations, i.e. ARCH or GARCH processes. Indeed, we have detected processes of this kind in over 70% of the sample. For these cases, the original estimation by OLS was replaced by ARCH or GARCH estimations, as necessary, with better statistical results.

The paper outlines as follows: section 2 summarizes theories and previous empirical studies; section 3 considers the sample and methods used; section 4 analyzes results; and section 5 presents the conclusions.

2. Theories and Empirical Evidence

There are several theoretical points of view trying to explain market reactions to the announcement of equity public offers. The most relevant theories on the topic summarize as follows.

Myers and Majluf (1984) have studied corporate financing and investment decisions under the assumption that management is better informed about the firm's value than outside investors. They have shown that in the best interest of existing shareholders, the better-informed managers can rationally turn down positive NPV projects. If the market significantly undervalues the company's assets, the dilution suffered by existing stockholders can be greater than any gains they might get from undertaking positive NPV projects. Hence, management will turn down equity issues and eventually the project that require equity financing. On the other hand, a decision to issue new equity and to invest in the project could signal an overvaluation of the company's assets. The under/over valuation of assets creates an adverse selection problem. The correct decision (to invest in projects with positive NPV) may be worse for stockholders; on the other hand, investors may find the firm needs financial resources, meaning that its expected future cash flow is not so good, which implies that its shares are overvalued. Thus, stock issue announcements may result in negative impacts on the stock price, thus explaining the negative abnormal returns.

Miller and Rock (1985) assume that managers know more about a firm's future cash flow than shareholders do, but there is no such informational asymmetry about both the level of planned investment and the value of the firm's assets conditional on current cash flow. In their model, the unanticipated decision to issue equity signals bad news about a company's future cash flows to finance its planned investment, which brings about a negative price response. The adverse selection problem and the timing of new issues have been in the core of the Lucas and McDonald (1990) signaling hypothesis. They have presented an asymmetric-information, infinite-horizon model of the equity issue

decision predicting that equity issues are on average preceded by an abnormal rise in the market and an abnormal positive return on the stock and that the stock price drops at the announcement of an issue.

Jensen and Meckling (1976) bring agency cost implications for the new equity issues. In the United States, a relevant part of the executives' compensation is under the form of stock or stock options. Thus, in the decision process of issuing equities, agency costs might emerge from the divergence between managers and stockholders. Jensen (1986) relies on agency arguments in predicting market reactions to equity offerings. Managers are the shareholders agents, and because both parties are self-interested, there are serious conflicts between them over the choice of the best corporate strategy. The market reaction to the announcement of an equity offering will depend on its assessment of the probability that the firm will invest in positive NPV projects or not.

Scholes (1972) proposes that stock prices may drop at the announcement of an equity issue because there is a downward sloping demand for a specific security. The model antagonizes the hypothesis of efficient markets where the demand for equity is horizontal and stocks are close substitutes. Scholes' hypothesis rests on the assumption of an incomplete capital market with restricted short sales. Under these conditions, perfect substitutes for a firm's securities do not exist in the market. In the absence of perfect substitutes, firms face downward sloping demand curves for their securities. Scholes' hypothesis also predicts that an increase in quantity caused by a new issue of common stock results in a permanent decrease in the stock price.

Currently, most part of the existing empirical evidence supports the view that the market reacts negatively to the announcement of equity offerings. However, Hess and Frost (1982) have investigated price movements in the neighborhood of SEOs' issuing day. They compare three competing hypotheses: the SEC view that a new issue causes a permanent price decline; the underwriter view that there is only a temporary price decline during the distribution period; and the efficient market hypothesis that there are no price effects. They concluded for the rejection of the first two hypotheses in favor of the efficient market hypothesis.

Asquith and Mullins (1986) have shown that the announcement of equity offerings reduces stock prices significantly. They have found mean two-day announcement period excess return for primary issues of –3.0%. This negative stock price reaction representing the loss in firm value on the single announcement day is on average 31% of the funds raised in the primary offering. The findings are consistent with both the signaling hypothesis where equity issues are conveying negative information to the investors about the true value of the firm as well as the price pressure hypothesis that there is a downward sloping demand for securities.

An analysis performed by Mikkelson and Partch (1986) concluded that equity offerings are associated with a positive mean excess return between the announcement and a negative mean return at the issuance. The reason declared for the issue would also affect price response. The study reports a higher price drop in response to common stock issues to refinance debts than to finance capital investments. This evidence is consistent with Myers and Majluf (1984) and the

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argument that announcements of common stock and convertible security offerings convey that share price is too high. All types of unexpected new financings present negative price response, which is consistent with Miller and Rock's (1985) model leading market participants to lower their assessment of the firm's earnings prospects.

Gerard and Nanda (1993) have developed a model that predicts, *inter alia*, that on average secondary market prices drop in the days preceding the issue day, recover in the post issue market, and that the new shares sell at a discount from the market's expectation on the stock value at the time of issue.

Loughran and Ritter (1995) have shown that companies issuing stock during 1970 through 1990, whether initial issues or not, significantly underperforms relative to non-issuing firms for five years after the offering date. They have also shown that issuing firms have slightly higher betas than non-issuers, implying that issuers should have higher, not lower returns. In their own words, the reason why firms issuing equity produce such low returns for investors over the next five years constitutes a puzzle

Spiess and Affleck-Graves (1995) and Loughran and Ritter (1997) have shown that in addition to the negative announcement period returns, issuing firms experience abnormally low stock returns over the five years following the issue. One explanation for these findings is that managers time equity issues to take advantage of "windows" of opportunity to issue overvalued equity. This explanation requires not only that investors are overly optimistic about the issuing firms' prospects at the time of the issue announcement, but also that investors under-react to information conveyed by the issue. Although Fama (1998) has argued that these results reflect normal random variations that occur in efficient markets, the long-run post-announcement abnormal stock-price performance presents a challenge to the traditional paradigm of market efficiency.

Kadiyala and Rau (2001) developed two conflicting behavioral models, under-reaction and over-reaction respectively to explain long-run abnormal return phenomena following corporate events. The study provided evidence that negative abnormal returns can be attributed to the investor under-reaction model only. Investors under-react to short-term information available prior to the event and subsequently to the information conveyed by the corporate event.

Hertzel et al (2002) have examined post-announcement stock-price performance for a sample of firms that sell equity through private placements. They have found that despite having a positive stock-price reaction at the announcement, firms that issue equity privately significantly under-perform relative to several benchmarks over the three-year period following the offering. Furthermore, the negative post-announcement performance documented for private placements is similar to the long-run under-performance reported for initial public issues (IPOs) or seasoned equity issues (SEOs). Taken together, the evidence suggests that investors are too optimistic about the prospects of firms that issue equity, regardless of the form of issuance.

Leal and Amaral (2000) studied the Brazilian market reaction before the announcement of an equity issue sample and verified positive abnormal returns 60 days and 5 days before the announcement, showing possible manipulation by investors with insider information. The authors also verified negative market reactions at the announcement day, in agreement with the extant evidence mentioned above.

3. Methods

In the present study, 80 public equity issues carried out from 1992 to 2003 by firms listed in the Brazilian stock market were selected. The source of data is the Economatica® database. The study analyzes the abnormal returns observed in the period from 15 workdays before the issue announcement day to one year after the issue day.

Aiming at verifying if the data series are stationary, the amplified Dickey-Fuller test for unit roots (Dickey and Fuller, 1979) was applied to the 160 sample data series, i.e. to the 80 stock return series and to the 80 market return series to prevent the occurrence of spurious regressions in case such roots actually existed. The literature indicates that the stock prices trend to be non-stationary, while stock returns tend to be stationary (Brooks, 2002). We describe these results in the next section.

The methodology used in the study had as objective to verify:

(a) If there are abnormal returns in the period from 15 workdays prior to and the announcement, which would indicate the occurrence of insider information;

(b) If there are abnormal returns at the time of the announcement, as documented in preceding empirical studies;

(c) If the performance of stocks belonging to issuing firms is also negative in Brazil in the long term, as reported in the international literature.

There are two types of model for the empirical study of stock behavior in capital markets: price and return models. Because price models present complex econometric problems, return models are used more frequently. In this work, a given type of return model was used in connection with the method known in the literature as event study. References on the topic can be found, for example, in Brown and Warner (1985), Campbell, Lo and MacKinlay (1997), and MacKinlay (1997).

In the study, each event is defined as the announcement of an issue by a listed firm and the event day is the issue announcement day. The study uses daily returns, considering workdays only. The hypotheses tests are performed under the null hypothesis of non-existence of abnormal returns. With the purpose of capturing possible abnormal returns in the event window, the market model estimated by OLS was initially used.

3.1 Measurement of Abnormal Returns by OLS

There are alternative methods for computing abnormal returns, either by means of statistical or economic models. If the market model is used, abnormal returns are obtained through the difference between the actual stock returns and the predicted stock returns based on OLS estimation, having as explanatory variable the market return. This is expressed by:

(1)
$$AR = R - R^*,$$

where AR is the abnormal stock return of the *i-th* share on time *t*, R the actual stock return and R^* is the predicted return. The regression equation used to estimate parameters is given by:

(2)
$$R = R_m \beta + u.$$

R_m is a matrix with elements of the first column equal to one and the 2nd column formed by market returns through time. β is a column vector with the regression parameters and u is the column vector of random terms u_t assumed i.i.d. ~ N(0,σ^2). The predicted return is given by:

(3)
$$R^* = R_m \hat{\beta}, \qquad \text{where}$$

(4)
$$\hat{\beta} = (R_m' R_m)^- R_m' R,$$

where $\hat{\beta}$ is the vector of the linear regression estimated parameters for an estimation window prior to the event, and R_m is the matrix of market returns. In this study, the estimation window adopted for all samples events was of 105 workdays. Assuming that the R_m elements are exogenous with respect to R, the $\hat{\beta}$ parameters are unbiased and consistent estimations. Combining (2) and (3) results in:

(5)
$$AR = R - R_m \hat{\beta}.$$

The aggregation of abnorm returns through the sample of size *N* is given by:

(6)
$$\overline{AR} = \frac{1}{N} \sum_{i=1}^{N} AR.$$

The average daily abnormal returns obtained in (6) must be accumulated through time. Defining $\overline{CAR}(\tau_1, \tau_2)$ as the column vector components of the cumulative abnormal returns between days τ_1 and τ_2, so

(7)
$$\overline{CAR}(\tau_1, \tau_2) = \sum_{\tau_1}^{\tau_2} \overline{AR_t}.$$

Under the null hypothesis that $\overline{CAR}(\tau_1, \tau_2) = 0$, we have

(8)
$$\theta = \frac{\overline{CAR}(\tau_1, \tau_2)}{\left[\text{var}(\overline{CAR}(\tau_1, \tau_2)) \right]^{1/2}} \sim N(0,1).$$

3.2 Measurement of Abnormal Returns by ARCH/GARCH

Bollerslev (1986), Akgiray (1989) and Chiang and Doong (2001) showed that the daily stock returns present variable volatility along time, thus tending to present ARCH/GARCH effects. In this study, we decided to check for this occurrence by using the Engle (1982) test. Indeed, in 58 out of the 80 regressions associated to the events that compose the sample, we found that the null hypothesis of non-existence of ARCH effects should be strongly rejected. In this situation, the estimation by OLS is spurious, since the assumption that the residuals are i.i.d ~ $N(0,\sigma^2)$ is violated. For this reason, when detecting the presence of those effects, the regressions represented by (2) were re-estimated using GARCH or ARCH models. From the 58 cases, 13 cases resulted in ARCH (1) processes whereas 45 were regressed as GARCH (1,1) processes. If a GARCH (1,1) model is considered, the specification (2) is replaced by:

(9) $$R = R_m + u \qquad u_{it} \sim N(0,\sigma_{it}^2) \text{, where}$$

(10) $$\sigma_{it}^2 = \alpha_{i0} + \alpha_{i1}u_{it-1}^2 + \alpha_{i2}\sigma_{it-1}^2 .$$

This specification shrinks to an ARCH (1) process if $\alpha_{i2} = 0$.

The set of methods used in this study also included the White (1980) test for heteroscedasticity, the Jarque-Bera non-normality test (Bera and Jarque, 1981), and the Durbin-Watson test for residuals autocorrelation (Durbin and Watson, 1951). We also used the Cochrane-Orcutt estimation method (Cochrane and Orcutt, 1949) when the occurrence of autocorrelation in the OLS residuals was detected.

4. Results

As expected, the augmented Dickey-Fuller test resulted in rejection of H_0 related to the presence of unit roots in all series at the level of 1%, so that the series were considered as stationary or integrated I(0). A negative aspect is that the Jarque-Bera non-normality test at 5% revealed that in 39 of the regressions, the hypothesis H_0 of normality of the residuals is accepted, but it is rejected for the others. The normality of residuals is necessary for the t-tests validity. Fortunately, considering that in half of the sample the residuals were normal and the fact that the sample is sufficiently large ($N = 80$), the residuals normality violation in the other half of the sample is practically harmless, given the Central Limit Theorem.

With regards to the measurement of the abnormal returns by OLS, according to equation (2), the Durbin-Watson test revealed that in three regressions the null hypothesis of non-existence of serial correlation in the residuals was rejected. For these regressions, the Cochrane-Orcutt estimation method was used, which eliminates the autocorrelation problem.

Based on previous studies by Bollerslev, 1986; Akgiray, 1989; Chiang e Doong, 2001, we considered the possibility of existence of ARCH or GARCH effects in the regression residuals obtained by OLS. Accordingly, we

decided to apply the Engle (1982) test in the residuals of all 80 regressions, and the occurrence of these effects was found in 58 regressions. For this reason, we also decided to re-estimate these regressions using the ARCH (1) or the GARCH (1,1) models, according to equations (9) and (10) above. GARCH (1,1) models fitted better in 45 cases and ARCH (1) in 13 cases. For the 22 remaining regressions, which had shown no signs of heteroscedasticity, the original regressions by OLS were maintained. The regressions obtained by ARCH or GARCH have shown to be significantly superior to those estimated by OLS in terms of the t-test, the F test and R^2. The White (1980) test revealed no existence of other heteroskedastic processes besides ARCH or GARCH.

Graph 1 shows two series of daily cumulative abnormal returns: (a) those obtained with estimation by OLS for the whole sample and (b) those obtained by ARCH for 13 events, GARCH for 45 events, and OLS for 22 events. It can be seen that the estimation results by OLS only show lower abnormal returns if compared to the OLS/ARCH/GARCH combined estimation, indicating that the single OLS estimation is biased downwards. However, we can see that re-estimation of part of the sample by ARCH or GARCH does not change the general conclusions with regard to the market reaction.
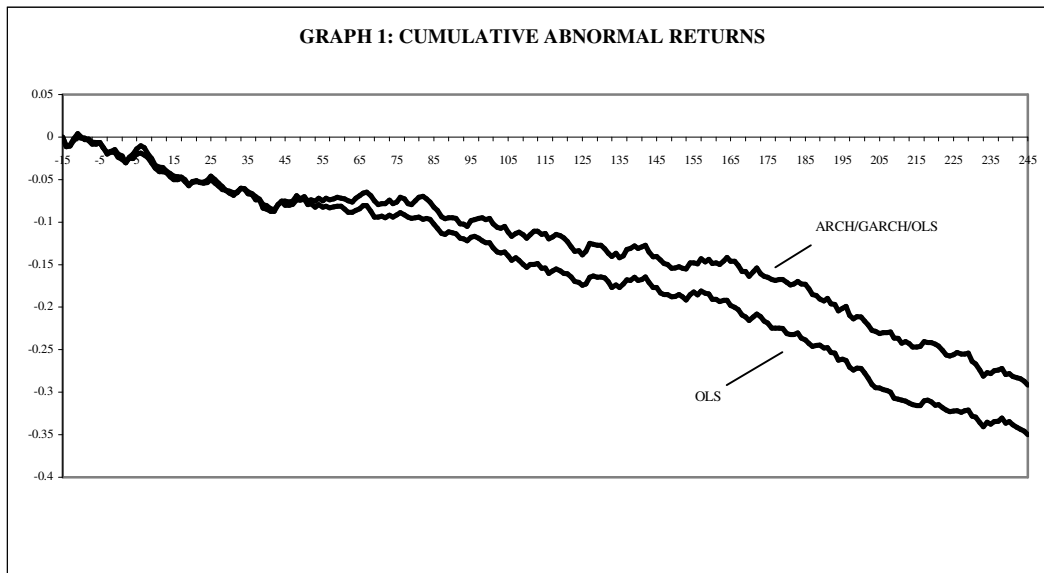

GRAPH 1: CUMULATIVE ABNORMAL RETURNS

Table 1 shows the daily simple and accumulated abnormal returns and corresponding t statistics estimated by OLS, ARCH or GARCH, according to the best fit, for the period of 15 days before and 15 days after the issue announcement. We observe the occurrence of significant negative abnormal returns on the 14th and 13th days prior to the announcement followed by non-significant returns. On the issue announcement day and the two subsequent days, significant negative abnormal returns are also verified. Between the 3rd and the 9th day after the announcement, abnormal returns are not significant, but from the 10th day on, the negative abnormal returns are significant until the end of the period of approximately one year (in workdays).

Based on these empirical results, we can say that:

(a) The market reaction to the issues in the pre-announcement period shows a negative abnormal return 14 workdays before the announcement (3 weeks), seeming to indicate the occurrence of insider information, since this anticipates the reaction that should occur on the announcement day;

(b) There are cumulative negative abnormal returns on the announcement day and on the two subsequent days; and

(c) The market reaction throughout approximately one year after the issue announcements indicates a persistent negative stock performance.

Table 1: Abnormal returns (AR), Cumulative abnormal returns (CAR), and t statistics, estimated by ARCH, GARCH and OLS								
day	AR	CAR	t (CAR)		day	AR	CAR	t (CAR)	
-14	-0.011	-0.011	-3.011	*	+1	-0.003	-0.027	-1.833	*
-13	0.000	-0.011	-2.080	*	+2	-0.003	-0.030	-1.986	*
-12	0.007	-0.004	-0.624		+3	0.006	-0.024	-1.523	
-11	0.003	-0.001	-0.077		+4	0.003	-0.020	-1.278	
-10	-0.001	-0.001	-0.160		+5	0.006	-0.014	-0.857	
-9	0.000	-0.001	-0.133		+6	0.004	-0.010	-0.588	
-8	-0.003	-0.004	-0.406		+7	-0.003	-0.012	-0.727	
-7	-0.004	-0.008	-0.799		+8	-0.007	-0.020	-1.119	
-6	0.000	-0.008	-0.775		+9	-0.006	-0.026	-1.427	
-5	0.002	-0.007	-0.589		+10	-0.007	-0.033	-1.797	*
-4	-0.005	-0.012	-0.988		+11	-0.003	-0.036	-1.911	*
-3	-0.008	-0.020	-1.567		+12	0.000	-0.036	-1.885	*
-2	0.002	-0.017	-1.325		+13	-0.004	-0.040	-2.084	*
-1	-0.001	-0.018	-1.333		+14	-0.003	-0.043	-2.185	*
0	-0.006	-0.024	-1.681	*	+15	-0.003	-0.046	-2.293	*
* Significant at 5%.								

5. Conclusion

In this paper we have undertaken an event study on the market reaction to a sample of 80 SEOs issued in the Brazilian stock market from 1992 to 2003. Initially, abnormal returns were calculated for each issue using the **market model** estimated by OLS. It was verified, however, the presence of ARCH or GARCH processes in the regression residuals in 70% of cases. For these cases, the regressions were re-estimated by ARCH or GARCH models, according to their best fit. Comparing the initial results to those that take into account the heteroscedastic processes, we verified that the original results indicate negative abnormal returns biased downwards with respect to the alternative estimation. However, the re-estimation, although leading to lower abnormal returns in absolute values, does not change the results qualitatively.

The results show that the stockholders seem to be cautious about firms that issue stock to raise funds with the argument they are investing in projects with positive NPV. When firms announce they are raising funds through the issue of new stocks, it can be inferred that these firms could be waiting for an opportunity window to issue. Thus, when the stock market reaches a given level in which these firm's shares are overvalued, stockholders are satisfied to sell part of their investment with profit. Actually, this shows that when companies announce the issue, there is a negative signaling to the market, which is in agreement with Myers and Majluf (1984) and Miller and Rock (1985).

As demonstrated in this study, in the period from 1992 to 2003, companies that raised funds through underwriting cannot equalize the benchmark, i.e. the Brazilian stock market index. One may infer that those with insider information sell their equity position about three weeks before announcement, since they expect the announcement will signal negative information about the true firm's value. The general conclusion is that there are significant negative abnormal returns about 3 weeks before the announcement, indicating the occurrence of inside information, which would anticipate what should only occur at the announcement day.

The results presented negative CARs of 4.6% 30 days around the announcement day, i.e. 14 days before and 15 days after. On the announcement day, a negative abnormal return (AR) of 2.4% was verified. We can say that the results obtained are consistent with most part of the previous empiric evidence, both in terms of negative abnormal returns to the announcement as well as throughout the 12 following months. The results seem to show that the market reaction to non-initial public equity issues in Brazil is not too different from that observed in the United States, at least when the period of one year is considered.

Comparing these results with the discussions presented in sections 2 and 3, we can say that they are consistent with the existing theoretical and empirical framework. The occurrence of negative abnormal returns three weeks before the issue announcement may be interpreted as evidence of insider information, since it seems to be an anticipation of what should occur only on the announcement day. However, this result is not in agreement with the results obtained by Leal and Amaral (2000) with regard to the pre-announcement period, since they found positive abnormal returns 60 and 5 days before the announcement. The result of the present study concerning the announcement day, however, is in agreement with Leal and Amaral (2000).

The negative abnormal returns related to the announcements are consistent with the asymmetric information hypothesis in which the management knows more about a firm's value than outsider investors are. More specifically, the results are in agreement with the hypotheses by Myers and Majluf (1984), and Miller and Rock (1985) that the issue conveys negative information concerning the future prospects of firms.

Our outcome does not contradict Lucas and McDonalds' (1990) signaling hypothesis. Although their model predicts that stock issues are on average preceded by an abnormal rise in the market and an abnormal positive return on

the stock, which was not observed in our study, it also accounts for market-relative price drops, i.e. negative abnormal returns following the issues.

The results here presented are also in agreement with Scholes (1972), Jensen and Meckling (1976), Asquith and Mullins (1986), Myers and Majluf (1984), Miller and Rock (1985), Spiess and Affleck-Graves (1995), and Loughran and Ritter (1995). These studies report negative abnormal returns in the long-term after the issues announcement. The upshot here obtained do not confirm the predictions of the model of Gerard and Nanda (1993) in which on average secondary market prices will drop on the days preceding the issue day and recover in the post-issue market, since such recovery was not verified. Similarly, when we compare our results to those of Hess and Frost (1982), we cannot confirm their conclusion that the SEC view (permanent price decline) and the underwriter view (temporary price decline) should be rejected in favor of the efficient market hypothesis (no price effect).

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