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Stock Returns and Volatility

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Abstract

This paper examines the relationship between stock returns and volatility over the period of June 1990 to April 2002. We study firm-level relationship between stock returns and volatility for a sample of 25 time series for Brazilian stocks. Using Seemingly Unrelated Regressions (SUR) empirical evidence suggests that contemporaneous returns and volatilities are significantly and positively correlated while there is a negative relationship between changes in volatility and stock returns. Finally, the "leverage effect" seems to hold for Brazilian stocks as shown by the results from an AR (1)-EGARCH(1,1) estimation.

Keywords: Stock Returns, Volatility, Seemingly Unrelated Regressions, EGARCH.
JEL Classification: G10, C53.

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1. Introduction

A lot of research has been done investigating the relationship between stock returns and volatility for developed markets. Black (1976) and Christie (1982) found that stock prices decline for individual firms raises financial leverage, which resulted in an increase in equity's volatility. They found a negative relationship between changes in volatility and stock returns. Cheung and Ng (1992) using EGARCH models also found evidence of negative relationship between the log of the one-day-ahead conditional volatility and stock returns.

This effect is commonly known in the literature as the "leverage effect". Black (1976) argued that a fall in a firm's stock value relative to the market value of its debt causes a rise in its debt-equity ratio and increases its stock volatility.

French, Schwert and Stambaugh (1987) examine the intertemporal relationship between volatility and expected returns for the U.S. and found evidence that the expected market risk premium is positively related to volatility of stock returns. Cheung and Ng (1992) analyze the relation between stock price dynamics and firm size and found evidence that conditional future volatility of equity returns is negatively related to the level of stock price and that this effect is stronger for small firms and with higher financial leverage.

Theodossiou and Lee (1995) inspect the intertemporal relationship between risk and expected return for ten industrialized countries. The authors use a GARCH in mean model and test for the conditional variance and expected market return relationship. They found no significant relationship between conditional volatility and expected return for any of these countries. Mougoné and Whyte (1996) study the connection between stock returns and volatility for the German and French equity markets. They have found that the impact of volatility on stock returns is insignificant.

De Santis and Imrohoroglu (1997) study the dynamics of expected returns and volatility for emerging markets and found that the level of volatility in emerging markets is considerably higher than that of more mature markets. They also scrutinize the issue of whether liberalization would increase/decrease volatility. They found evidence suggesting that country-specific risk does not play any role in explaining conditional expected returns.

Duffee (1995) claims that the reason for a negative relationship between stock returns and future changes in stock return volatility is that a positive stock return corresponds to an increase in current volatility. He tested this assertion and found a strong positive contemporaneous relation between firm stock returns and volatility, both using daily and monthly data.

This paper tests whether there is a contemporaneous relation between stock returns and current and future volatility for Brazilian stocks, employing Seemingly Unrelated Regressions. The data covers the period of June 1990 to April 2002. A robustness test has been done analyzing two sub-periods. The first sub-period covers June 1990 to August 1994 while the second August 1994 to April 2002, to account for changes in stock market due to the Real stabilization plan, which has been successful in reducing inflation in Brazil. Empirical evidence suggests that as in the U.S. case studied by Duffee (1995) Brazilian stocks have a positive relationship between stock returns and contemporaneous volatility. Furthermore, using nonparametric techniques we test for firm size, market capitalization and debt/equity ratios as potential explanatory variables for results found.

To the best of our knowledge this is the first paper that addresses the relationship between volatility and stock returns for the Brazilian stock market. This paper focuses on this relationship using two methodologies. The relationship between stock returns and volatility is tested using single regressions methods for the most liquid stocks and Nelson's (1991) exponential GARCH, basically an AR(1)-E-GARCH(1,1) estimation. Results found provide evidence that for the Brazilian stock market there is a strong relationship between stock returns and current volatility.

The paper is organized as follows. In the next section the methodology that is used in the paper is described. Section 3 discusses the data used in the paper and the sampling approach. Section 4 presents empirical results while section 5 concludes the paper.

2. Methodology

Most studies have analyzed the relationship between changes in volatility and stock returns in a single-equation framework similar as in (1).

$$\left(V_{t+1} - V_t\right)/\overline{V} = \alpha_0 + \delta_0 r_t + \eta_{t+1} \tag{1}$$

where V_t represents volatility in instant t, r_t stands for the current return, α_0 and δ_0 are coefficients that can be estimated by Ordinary Least Squares (OLS) and η_{t+1} is an error generally assumed to be serially uncorrelated and normally distributed, and $\overline{V}$ is the average volatility that is used to scale coefficients for all firms. Most studies as Black (1976) and Christie (1982) have found that δ_0 is significantly negative. Duffee (1995) has argued that this negative link is due to a positive relationship between stock returns and current volatility.

We follow Duffee (1995) using daily data as a proxy for day t's return volatility the absolute value of day t's return.[†]. Thus, volatility is defined as $V_t = |r_t|$. The mean daily absolute return for the entire sample is used to scale estimated coefficients for different firms for daily volatility regressions. Duffee (1995) suggests running (1) and two other regressions.

$$V_t/\overline{V} = \alpha_1 + \delta_1 r_t + \varepsilon_t \tag{2}$$

$$V_{t+1}/\ \overline{V} = \alpha_2 + \delta_2 r_t + \upsilon_{t+1} \tag{3}$$

He found evidence that δ_1 is significantly positive for a sample of 2494 North American firms, while a much weaker relation has been found for δ_2 depending on the sampling frequency.

We estimate a linear system of equations in which a separate equation is estimated for each firm using generalized least squares. As the coefficients are estimated for overlapping time period's shocks to returns and volatilities induce dependence between the coefficients. The Seemingly Unrelated Regression (SUR) methodology takes into account such cross-correlations and results in more efficient estimates than ordinary least squares (OLS) estimation. Therefore, a SUR methodology is used.

We analyze the mean coefficients for regressions (1-3) and test for the sign of these coefficients. However in order to make inference on these coefficients we need to correct the standard errors as there is correlation among the coefficients for different stocks. The variance of the mean coefficient $VAR(\bar{\delta}_{i,j})$ where the *i* stands for the *i*-th firm and the j for the regression type, where j=1, 2 or 3, is given as:

$$VAR(\bar{\delta}_{i,j}) = VAR\left(\frac{1}{N}\sum_{i=1}^{N}\delta_{i,j}\right) = \frac{VAR(\delta_j)}{N}[1+(N-1)\bar{\rho}] \tag{4}$$

where $\bar{\rho} = \frac{1}{N(N-1)}\sum_{i=1}^{N}\sum_{\substack{k=1 \\ k\neq j}}^{N}\rho_{ik}$ and ρ_{ik} stands for the correlation between coefficients for different firms, and $VAR(\delta_j)$ is the variance of coefficient δ_j.

We use the sample variance to estimate this variance and the mean correlation between coefficients running seemingly unrelated regressions for firms.

Another approach that we use in this paper is that we estimate an AR(1)-E-GARCH(1,1) for all stocks and test for the significance of the "leverage effect". The model estimated is given below:

$$r_t = \phi_0 + \phi_1 r_{t-1} + \upsilon_t \tag{5a}$$

$$\upsilon_t = \sqrt{h_t}\,\varepsilon_t \qquad \varepsilon_t \sim N(0,1) \tag{5b}$$

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† Duffee (1995) argue that as daily stocks are characterized by fat tails it is more efficient to estimate volatility relationships with absolute rather than squared residuals.

$$h_t = \omega + \beta \log h_{t-1} + \alpha \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \tag{5c}$$

The "leverage effect" is captured by the coefficient γ in (5c). If this coefficient is significant then positive shocks and negative shocks have different impacts on volatility. To test for the association between estimated parameters and firm's size (measured by market capitalization and total assets) and debt equity ratios we use a nonparametric test following Cheung and Ng (1992) and Duffee (1995).

We use Spearman rank correlation that considers paired data $\{(z_i, w_i); i = 1,2,...,n\}$. The correlation coefficient is given as:

$$r_s = \frac{Cov(r_{z_L}, r_{w_L})}{\sigma_{z_i} \sigma_{w_i}} \tag{6}$$

where r_{x_L} is the rank assigned to x_i and has a standard deviation σ_{x_L}, where $x = (z, w)$.

3. Data Sampling

One of the main problems that emerging markets face is the lack of liquidity for many stocks that are listed in the Exchange. This is not different for the Brazilian stock market.

We have selected stocks from the Index of the São Paulo Stock Exchange (the São Paulo Stock Exchange (BOVESPA) accounts for more than 90% of Brazilian stock market capitalization) as only the most liquid stocks enter the BOVESPA Index.

From the 57 stocks that entered the index only 25 stocks whose price series begun in June 1990 were selected. Differently from Duffee (1995) most stocks have missing observations. Only two stocks, namely Bradesco and Itaú had no missing observations with a total of 2928 observations.

In order to run SUR for these stocks we selected 10 stocks, as we would not have to fill in more than 24 missing observations for these series, which would represent 0.87% of total observations. The SUR was estimated using this 10 stocks representing "continuously traded" firms.

We have also included in our sample the other 15 stocks. Embraer only had 2318 observations for the same time period, representing the stock with the greatest number of missing observations. While Itausa had 2900 observations. All other stocks sample range from 2318 to 2900 observations.

We run OLS regressions with these 15 stocks and analyze the mean coefficients in equations (1-3) adding the 10 "continuously traded" stocks. Thus we have the mean coefficient for 25 stocks, representing the average relationship between stock returns and current and future volatility for the Brazilian stock market.

4. Estimating the relation between stock returns and volatility.

In order to analyze results from regression (1-3) we first test for stationarity of the return and volatility time series. We perform Augmented Dickey and Fuller (1981) unit root tests using a modified Akaike to select the optimal number of lags as suggested in Ng and Perron (1995, 2001).

Table 1 presents results for the unit root tests and evidence suggests that all series can be regarded as stationary as the null of a unit root is rejected in all cases for both stock returns and volatility with 99% level of confidence.

Table 1. Unit Root ADF tests

Firms	Returns	Volatility
Ambev	-36.3482*	-6.9382*
Bradesco	-48.2009*	-7.3850*
Brasil	-52.2031*	-7.0667*
Cemig	-9.2783*	-6.5843*
Copene	-10.8224*	-7.2406*
Itaú	-46.6761*	-7.5082*
Klabin	-9.6629*	-6.8132*
Petrobras	-10.8630*	-6.9191*
Telesp	-9.5276*	-7.0632*
Vale	-14.3941*	-7.0206*

* Statistically significant at the 99% confidence level

The next step is to estimate (1-3) and check the sign of coefficients δ_0, δ_1 and δ_2. Table 2 presents the results using SUR for 10 "continuously traded" stocks. As we can see results are in line with the findings of Duffee (1995). For all stocks coefficient δ_0 is significantly negative as in Black (1976), Christie (1982) and Duffee (1995).

Nonetheless, the coefficient δ_1 is significantly positive implying a positive contemporaneous relation between stock returns and current volatility. Evidence on the δ_2 coefficient is much weaker.

Table 2. Seemingly Unrelated Regressions of firm stock return volatility on firm stock returns, June 1990 to April 2002, using dollar denominated returns.

Firms	δ_0	δ_1	δ_2
Ambev	-3.4633*	4.8902*	1.2335*
	(0.6251)	(0.4663)	(0.4703)
Bradesco	-3.3126*	5.7114*	2.0300*
	(0.5695)	(0.4298)	(0.4366)
Brasil	-2.3823*	3.2430*	0.7579**
	(0.4848)	(0.3488)	(0.3532)
Cemig	-3.3904*	4.8046*	1.3786*
	(0.4207)	(0.3131)	(0.3204)
Copene	-2.1649*	5.2948*	2.8258*
	(0.6195)	(0.4579)	(0.4633)
Itaú	-3.0177*	6.9218*	3.5390*
	(0.5976)	(0.4597)	(0.4689)
Klabin	-5.9918*	5.7629*	-0.3273
	(0.6378)	(0.4929)	(0.5024)
Petrobras	-3.2397*	3.3553*	0.0761
	(0.4453)	(0.3288)	(0.3307)
Telesp	-2.6820*	3.6121*	0.8261**
	(0.4543)	(0.3405)	(0.3430)
Vale	-3.4127*	4.1370*	0.7274***
	(0.5097)	(0.3763)	(0.3801)

* Statistically significant at the 99% confidence level
** Statistically significant at the 95% confidence level
*** Statistically significant at the 90% confidence level
Standard errors are given in parenthesis.

Despite significance of these coefficients we have found evidence of instability. Using CUSUM test we have found evidence suggesting a structural break in 1994. We have also performed a CHOW test and a structural break could no be rejected for mid 1994. Hence, as robustness checks of the results we perform these SUR for two different sub-periods. The first period begins in June 1990 and ends in August 1994 while the second begins in August 1994 and ends April 2002. Table 3 presents results for the firs sub-period while table 4 for the second sub-period. CUSUM test show that coefficients are relatively stable for these sub-periods.

As we can see from tables 3 and 4 results are qualitatively the same indicating that when using dollar-denominated returns both periods show strong evidence supporting Duffee's (1995) assertion.

Table 3. Seemingly Unrelated Regressions of firm stock return volatility on firm stock returns, June 1990 to August 1994, using dollar denominated returns.

Firms	δ_0	δ_1	δ_2
Ambev	-4.8862*	6.1368*	1.1877
	(1.0139)	(0.7370)	(0.7487)
Bradesco	-1.3769	6.2097*	4.5491*
	(0.9996)	(0.7530)	(0.7594)
Brasil	-3.9794*	5.1979*	1.0988***
	(0.8318)	(0.5777)	(0.5959)
Cemig	-3.8528*	6.1436*	2.1826*
	(0.7283)	(0.5347)	(0.5562)
Copene	-2.8368*	7.0802*	3.8669*
	(1.0608)	(0.7590)	(0.7758)
Itaú	-3.3211*	8.7467*	5.1770*
	(1.0540)	(0.8133)	(0.8382)
Klabin	-6.1880*	7.5099*	1.2757
	(1.0872)	(0.8190)	(0.8445)
Petrobras	-3.6041*	3.9668*	0.3451
	(0.7684)	(0.5507)	(0.5554)
Telesp	-2.0438**	3.7914*	1.6319*
	(0.7972)	(0.5866)	(0.5898)
Vale	-4.2188*	4.5506*	0.3349
	(0.8288)	(0.6022)	(0.6090)

* Statistically significant at the 99% confidence level
** Statistically significant at the 95% confidence level
*** Statistically significant at the 90% confidence level
Standard errors are given in parenthesis.

From table 3 we can see that for all 10 stocks the coefficients δ_0 have a negative sign as found in previous studies such as in Black (1976), Christie (1982) and Duffee (1995). Even so, we have tested whether the primary reason for this negative relationship would be as suggested by Duffee (1995) that positive returns correspond to increases in current volatility. As we can see, the sign of the δ_1 coefficients is significantly positive for all series, which suggest that our sample behaves quite similarly to U.S. stocks.

Table 4. Seemingly Unrelated Regressions of firm stock return volatility on firm stock returns, August 1994 to April 2002, using dollar denominated returns.

Firms	δ_0	δ_1	δ_2
Ambev	-1.5200***	2.7248*	0.9460
	(0.8056)	(0.6112)	(0.6123)
Bradesco	-5.3494*	4.7641*	-0.8256
	(0.6582)	(0.4991)	(0.5046)
Brasil	-0.4782	0.7015	0.2212
	(0.5822)	(0.4326)	(0.4341)
Cemig	-2.5514*	2.0484*	-0.4648
	(0.4917)	(0.3579)	(0.3583)
Copene	-1.1816	2.6768*	1.3294**
	(0.7526)	(0.5749)	(0.5766)
Itaú	-3.0481*	4.5731*	1.4421*
	(0.6914)	(0.5276)	(0.5300)
Klabin	-5.9580*	5.2051*	-0.8526
	(0.7801)	(0.6015)	(0.6114)
Petrobras	-3.1726*	2.4880*	-0.6601
	(0.5306)	(0.4026)	(0.4031)
Telesp	-3.6794*	2.8352*	-0.9042**
	(0.5260)	(0.4011)	(0.4029)
Vale	-2.4175*	3.4934*	1.1184**
	(0.6558)	(0.4892)	(0.4947)

* Statistically significant at the 99% confidence level
** Statistically significant at the 95% confidence level
*** Statistically significant at the 90% confidence level
Standard errors are given in parenthesis.

We turn next to analyze aggregate relationships between stock returns and volatility. Table 5 presents results for the mean coefficients for the 10 stocks and uses the corrected standard error suggested in (4). As we can see results are qualitatively the same for the entire sample and for both sub-periods suggesting that there is indeed a strong positive relationship between stock returns and current volatility.

Table 5. Summary of Regressions of firm stock return volatility on firm stock returns. Sample of 10 firms.

Sample	Mean δ_0	Mean δ_1	Mean δ_2
June 1990 - April 2002	-3.3057*	4.7733*	1.3067*
	(0.4103)	(0.4840)	(0.4835)
June 1990 - August 1994	-3.6308*	5.9334*	2.1650*
	(0.5373)	(0.6441)	(0.7063)
August 1994 - April 2002	-2.9356*	3.1510*	0.1350
	(0.6577)	(0.5429)	(0.3874)

* Rejection of the null with 99% level of confidence

In table 6 we perform OLS regressions on the 15 "non continuously traded" stocks and make some inferences on mean coefficients δ_0, δ_1 and δ_2 for all 25 stocks using corrected standard errors given in (4).

Table 6. Summary of Regressions of firm stock return volatility on firm stock returns. Sample of 25 firms.

Sample	Mean δ_0	Mean δ_1	Mean δ_2
June 1990 - April 2002	-3.1360*	4.1088*	0.9090*
	(0.4446)	(0.5406)	(0.3653)
June 1990 - August 1994	-3.9354*	5.5324*	1.5460*
	(0.5693)	(0.6702)	(0.4568)
August 1994 - April 2002	-2.0502*	1.9595*	-0.1238
	(0.5819)	(0.6641)	(0.3953)

* Rejection of the null with 99% level of confidence

From table 6 we can see that even when taking into account more stocks, results remain qualitatively the same. The relationship between stock returns and future volatility is not clear. In both tables 5 and 6 the coefficient δ_2 is not significant for the second sub-period, while it is significantly positive for the first sub-period and when using the entire sample, suggesting some instability. Nonetheless, the coefficient on current volatility (δ_1) is significantly positive in all cases but is significantly smaller for the second sub-period (approximately half if we use the reduced sample and one third if we use 25 stocks).

The next step is to present the AR (1)-EGARCH(1,1) estimation. In table 7 we show results for the entire period.

Table 7. AR(1)-EGARCH(1,1) estimates for the 10 stocks sample. Sample: June 1990-April 2002.

Firms	ω	β	α	γ
Ambev	-0.3269*	0.9739*	0.1991*	-0.0311*
	(0.0271)	(0.0028)	(0.0119)	(0.0059)
Bradesco	-0.7629*	0.9305*	0.3839*	-0.0087
	(0.0598)	(0.0081)	(0.0165)	(0.0101)
Brasil	-0.2291*	0.9786*	0.1272*	0.0098
	(0.0295)	(0.0036)	(0.0117)	(0.0071)
Cemig	-0.2463(	0.9874*	0.2189*	-0.0165**
	(0.0197)	(0.0021)	(0.0133)	(0.0072)
Copene	-0.2459*	0.9834*	0.1846*	-0.0119***
	(0.0201)	(0.0023)	(0.0107)	(0.0063)
Itaú	-0.6290*	0.9379*	0.2722*	-0.0232**
	(0.0455)	(0.0064)	(0.0108)	(0.0096)
Klabin	-0.7627*	0.9187*	0.2839*	-0.0208***
	(0.0727)	(0.0093)	(0.0169)	(0.0107)
Petrobras	-0.3234*	0.9799*	0.2453*	-0.0447*
	(0.0266)	(0.0030)	(0.0148)	(0.0077)
Telesp	-0.3875*	0.9733*	0.2910*	-0.0427*
	(0.0252)	(0.0036)	(0.0132)	(0.0081)
Vale	-0.3891*	0.9715*	0.2549*	-0.0312*
	(0.0359)	(0.0039)	(0.0179)	(0.0095)

* Statistically significant at the 99% confidence level
** Statistically significant at the 95% confidence level
*** Statistically significant at the 90% confidence level
Standard errors are given in parenthesis.

Residuals for some of these regressions seemed to have some degree of autocorrelation.

We didn't try to find the best model by the means of any information criteria but to estimate a parsimonious model as suggested in the literature. If we include all 25 stocks we have that γ is significantly negative for over 80% of the firms. In only one case this coefficient is significantly positive and for four firms it is not significant. Thus, asymmetric effects on conditional volatility seem to be present form most stocks. A negative γ implies that negative shocks to stock returns tend to have a larger impact than positive shocks a finding that is in line with Cheung ang Ng (1992) and most of the literature.

Table 8 presents results for the second sub-period.

Table 8. AR (1)-EGARCH(1,1) estimates for the 10 stocks sample. Sample: August 1994-April 2002.

Firms	ω	β	α	γ
Ambev	-0.6270*	0.9401*	0.2578*	-0.0720*
	(0.0599)	(0.0067)	(0.0194)	(0.0108)
Bradesco	-0.8139*	0.9238*	0.3537*	-0.1024*
	(0.0893)	(0.0113)	(0.0240)	(0.0150)
Brasil	-0.4484*	0.9474*	0.1376*	-0.0181***
	(0.0848)	(0.0118)	(0.0156)	(0.0110)
Cemig	-0.4220*	0.9600*	0.1892*	-0.0962*
	(0.0608)	(0.0073)	(0.0212)	(0.0138)
Copene	-0.2994*	0.9779*	0.1939*	-0.0320*
	(0.0299)	(0.0035)	(0.0145)	(0.0079)
Itaú	-0.8366*	0.9154*	0.2992*	-0.0891*
	(0.1066)	(0.0134)	(0.0260)	(0.0152)
Klabin	-0.5219*	0.9485*	0.2309*	-0.0519*
	(0.0577)	(0.0073)	(0.0142)	(0.0117)
Petrobras	-0.5096*	0.9548*	0.2416*	-0.1121*
	(0.0534)	(0.0068)	(0.0199)	(0.0116)
Telesp	-0.8143*	0.9214*	0.3514*	-0.1172*
	(0.0909)	(0.0119)	(0.0257)	(0.0162)
Vale	-0.6070*	0.9471*	0.3009*	-0.0523*
	(0.0006)	(0.0068)	(0.0224)	(0.0150)

* Statistically significant at the 99% confidence level
*** Statistically significant at the 90% confidence level
Standard errors are given in parenthesis.

Residuals for these regressions look much nicer than before. As we can see the leverage coefficient is significant for all stocks and we test for all 25 stocks we find that for 96% of the firms this coefficient is significantly negative a result that is in line with the findings of Cheung and Ng (1992).

The log-likelihood statistics are large for both sub-periods suggesting that the AR(1)-EGARCH(1,1) is a fair representation of daily returns. The EGARCH parameter is statistically significant for all stocks. In both tables the β coefficients are considerably larger than α, which implies that large market surprises induce relatively small revisions in future volatility.

We have also run AR (1)-E-GARCH(1,1)-M estimation and found evidence in line with previous studies for the U.S. and industrialized which have found that the standard deviation in the mean equation is not significant. Out of the 10 "continuously traded" firms only two had a significant M-term.

5. Firm size and leverage

For all firms we have calculated the mean debt/equity ratio, market capitalization and total assets for the entire period and for the August 1994 April 2002 sub-period.

We have used Spearman rank correlation (nonparametric statistic) to check whether the magnitude of the coefficients in the regressions relating volatility and stock returns and in the AR (1)-EGARCH(1,1) were related to these variables.

Nonetheless, in all cases these correlations were not significant for both the entire sample and for the second sub-period. This could be due to two main factors. In the first place, our sample may not be representative of the entire universe and diversity of Brazilian stocks as is very small. Besides, infrequent trading may have influenced the coefficients on the regressions and should be treated somehow.

6. Conclusions

In this paper we have tested the relationship between stock returns and current and future volatility. In line with the findings of Cheung and Ng (1992) and Duffee (1995) we have found evidence suggesting that stock returns are significantly related to current volatility while the relation with future volatility is much weaker.

We have found that there is a structural break in 1994 in the behavior of stock series dynamics. As coefficients on our regressions are unstable and this period has been identified as the major cause of instability. Therefore, we have presented results for the period prior to August 1994 and afterwards.

Evidence presented using both a SUR methodology and an AR (1)-EGARCH(1,1) estimation suggests that changes in volatility are negatively related to stock returns, a result that has been found in the literature examining this relationship since Black (1976). Many explanations have been given for this phenomenon.

Duffee (1995) has argued that this relationship has been found to be negative due to a positive relation between current volatility and stock returns. This test has been applied to 25 Brazilian stocks and we found evidence that Duffee's hypothesis cannot be rejected.

We have finally used Spearman rank correlation (nonparametric statistic) to check whether the magnitude of the coefficients in the regressions relating volatility and stock returns and in the AR (1)-EGARCH(1,1) were related to variables such as firm size (measured by market capitalization and total assets) and debt/equity ratios. These correlations were not significant for the entire sample and for sub-periods analyzed.

Further analysis on these issues is crucial. An interesting extension of this paper would be to use local currency-denominated returns and tests for exchange rate effects on the results. Furthermore, extending the stocks used in our sample will be of some help. Finally, exploring more in depth issues of infrequent trading and the implications for results obtained in this paper would be interesting.

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