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Elusive Anomalies in the Brazilian Stock Market

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We study the twist-of-the-Monday effect in the Brazilian stock market and provide evidence that it is due to index construction problems, such as the non-synchronous trading of stocks. The effect is present for indices but absent for most individual stocks and in the most recent sub-periods of the 1986-98 period. When present, it was due to negative weekend returns while Monday intraday returns were significantly positive. When absent, Monday returns remain positively correlated with the previous week return although Monday returns are no longer significantly negative. Monday trading strategies based on the previous week return were profitable in and out of the sample.

1 INTRODUCTION

The random walk model describes the behavior of the market and implies its weak form efficiency. Yet many well known patterns have defied this theory. Campbell, Lo and MacKinley (1997), Hawawini and Keim (1995), and Thaler (1987) to cite only a few recent surveys, have cataloged many of the so called anomalies in several markets. Some of these patterns are related to specific calendar events and are known as calendar or seasonal anomalies. Many calendar anomalies have been recognized and a vast literature on the subject is available. Earlier research focused on the discovery of anomalies or the search for known anomalies in other markets. Lately, research on calendar anomalies has questioned the previous findings and the persistence of anomalies in recent periods.

Campbell, Lo and Mackinley (1997) present evidence from many empirical studies that "the degree of predictability seems to be declining through time". Agrawal and Tandon (1994) point to various US studies indicating that the Monday effect seemed to have recently disappeared. Connolly (1989) states that the day-of-the-week effect in the US seems to be dependent on the time period and the statistical technique utilized. Robust distribution free statistics indicates that both the day-of-the-week effect and the weekend effect have disappeared from the US market by 1975. In contrast, Chang et al. (1993) use Connolly's robust methodology and find evidence for the day-of-the-week effect in European and Asian markets. Dubois and Louvet's (1996) findings for Europe and Asia are

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consistent with those of Chang et al. (1993). Agrawal and Tandon (1994), however, state that the Monday effect was present in the seventies but that it was mostly absent in the eighties for their sample of 18 countries that includes Brazil.

Many local and foreign researchers have studied the Brazilian stock market, one of the largest emerging markets in the world. Agrawal and Tandon (1994), Aggarwal and Leal (1996), Lemgruber et al. (1988), Costa Jr. (1990), Costa Jr. and Lemgruber (1993), Almeida et al. (1993), and Leal and Sandoval (1994) have found that returns are significantly lower on Mondays in Brazil. In addition, Costa Jr. and Lemgruber (1993) find that the lower returns on Monday occur from the opening to the closing of Monday trading. The first panel in Table 1 summarizes the empirical literature addressing day-of-the-week anomalies in Brazil.

Jaffe et al. (1989) first used the term twist-of-the-Monday effect to indicate that negative returns on Mondays actually follow a decline in the market during the prior week and that they disappear when the market rises in the previous week. Abraham and Ikenberry (1994) confirm that Monday returns are negative 80 percent of the time after a negative return on Friday. They attribute this to individual investors who are more active during the first trading hours of Monday. Agrawal and Tandon (1994) and Aggarwal and Leal (1996) found a twist-of-the-Monday effect for the Brazilian stock indexes. Leal and Sandoval (1994) confirmed these results using conservative non-parametric tests. Jaffe et al. (1989) state that the presence of such effect in an index may be due to serial correlation caused by non synchronous trading of the individual stocks in the index. Nevertheless, it may be profitable to exploit such pattern.

The three studies in table 1 that found a significant evidence for the twist-of-the-Monday effect in Brazil use only index returns. Because this is typical of many emerging market studies, it is important to verify if their findings can be replicated using individual stocks. Thus, the goal of this study is to analyze the presence of the twist-of-the-Monday effect in the Brazilian stock market in detail and in more recent periods. We use index and individual stock data. We intend to exploit possible investment strategies. We will verify if Monday's returns following weeks of stock market decline are significantly negative and if they are significantly different from Monday returns following weeks of stock markets rises. This last test is actually an investment strategy that consists of a long position in the index or stock after a rising week and a short position in the index or stock when the return of the previous week is negative. In addition, we will determine if the anomaly is present in all sub-periods. We will test the consistency of the effect in several different ways. Finally, we will use non-parametric statistics, which are less sensitive to outliers and more robust due

to non-normal distributions, such as those present in Brazil. We hope to contribute to the calendar anomaly literature in emerging markets by showing that such anomalies are not consistent through time and are dependent on index construction methods.

2 DATA AND METHODOLOGY

The sample consists of daily local currency opening and closing levels of the IBOVESPA index and prices of the most liquid stocks for the period from 1/2/1986 through 6/2/1998. The data were obtained from the Economática database and the São Paulo Stock Exchange supplied the evolution of the IBOVESPA portfolio.

The IBOVESPA index is made up of the most liquid stocks at the São Paulo Stock Exchange. The index portfolio is rebalanced every four months and is liquidity weighed. The index consists of a variable number of stocks, usually around 55. Investors implementing a strategy to exploit any anomalies may prefer to replicate the index with fewer stocks. Therefore, two indexes were created using from 10 to 13 stocks among the most liquid ones in every four-month period. The first index is liquidity weighed according to the IBOVESPA criterion. The second index is not weighed. Both are rebalanced when the IBOVESPA is.

Monday returns were calculated as log differences between the closing of the previous Friday and the closing of Monday. The sample of Monday returns was then divided in two. One corresponding to positive previous week returns and the other to negative previous week returns. Previous week returns were calculated as simple raw percentage returns from the closing of Monday to the closing price of Friday in that week. When there was no return for the previous week (i.e. no trading on the previous Monday or Friday) the corresponding Monday return was removed from the sample.

In order to verify the significance of the difference between the returns of the two sub-samples (returns on Mondays following weeks of decline and returns on Mondays following weeks of rises) we use the chi-square test, the Wilcoxon rank sum test, and the Spearman's rank correlation test. The chi-square test verifies if the medians differ significantly. The Wilcoxon test identifies if the rank distribution, and thus the median, of the returns significantly differ in the two sub-samples. The Spearman test indicates if the Monday return is correlated to the dummy variable indicating if the previous week had positive or negative returns.

3 FINDINGS

3.1 Twist-of-the-Monday effect for indexes and individual stocks

Figure 1 illustrates the twist-of-the-Monday effect for the IBOVESPA index in the 1986-1998 period. The figure presents the medians of the returns for each day of the week according to the previous week return and suggests that the Monday's returns are strongly influenced by previous week returns. Mondays following weeks of declining returns have significantly negative returns, with a median return of $-1.13\%^2$. Monday returns following weeks of positive returns are not significantly negative and are significantly greater than Monday returns following weeks of negative returns. Table 2 summarizes these findings. The twist-of-the-Monday effect is also significant for the two indexes that use the most liquid stocks. Our results are consistent with those of Agrawal and Tandon (1994), Aggarwal and Leal (1996) and Leal and Sandoval (1994) for earlier periods.

3.2 Consistency of the Twist-of-the-Monday effect

The tendency to follow the returns over the previous week is limited to Monday. In table 2 we show that the median returns for the other days of the week are always positive and seem unrelated the previous week's returns³. In addition, there is no significant difference between the median returns of the two sub-samples for the other days of the week. We conclude that returns on the other days of the week do not follow the returns of the previous week.

In order to verify if the twist-of-the-Monday is unique, we run the same group of tests on the other days of the week. We had to redefine how the previous week return was computed. For example, for Tuesdays, the previous week return was measured from the market closing on the previous Tuesday to the market closing of the Monday of the present week (the prior day). Table 3 summarizes the results. None of the indices presented significant negative returns for any of the weekdays following the redefined previous week decline as well as a significant difference between the returns for the sub-samples. An effect similar to the twist-of-the-Monday effect was not found for any of the other days of the week and was present only for the closing of Friday to the closing of Monday returns.

² Curiously, the Monday effect is not present, as the median of returns for all Mondays is 0.07% and its significance level is 0.7848 . This is not consistent with most studies in table 1 and may be due to the inclusion of a recent period.

³ Positive median returns conform to a stochastic process with an upward trend.

Jaffe et al. (1989), among others, point out that there exists a positive correlation between the Monday return and the previous Friday return. In order to control for this potential correlation, we run the same tests excluding the previous Friday returns and redefining the previous week return computed between the closing of the previous Monday to the opening of the previous Friday. Table 4 shows the results for two definitions of the “previous week”. The twist-of-the-Monday effect is even more pronounced when we use Friday’s return only instead of the return over the entire previous week. However, the anomaly remains significant when the previous week excludes the previous Friday return, showing that the index anomaly is present regardless of the previous Friday’s return.

3.3 Weekend and Monday intraday returns

Rogalski (1984) renamed the Monday effect the “weekend effect” and suggested that the decline observed on Monday actually occurred during the non trading weekend period from the closing of Friday trading to the opening of Monday trading. For the weeks with declining returns only, we calculate the returns from the closing of Friday trading to the closing of Monday trading (the Monday return just presented in table 2), from the closing of Friday trading to the opening of Monday trading (the weekend period), and from the opening of Monday trading to the closing of Monday trading (the Monday intraday return). Table 5 presents the results. The negative returns following a week of decline actually occur during the weekend for the three indices. Moreover, the intraday Monday return is significantly positive for the three indices⁴. We could suggest that a more appropriate name for the twist-of-the-Monday effect is the “twist-of-the-weekend effect”.

3.4 Individual stock analysis

When the most commonly traded securities in the Brazilian stock market are analyzed individually, there is no strong evidence of the twist-of-the-Monday effect⁵. Of the 44 securities analyzed, only three presented returns on Mondays following weeks with negative returns that were significantly different from the returns following weeks with positive returns with the Monday following the week with negative returns being significantly negative. For 23 stocks, the difference was significant as well, however the return of the Mondays following weeks of negative returns was not significantly negative. For the remaining 18 stocks, neither the difference between the two samples and the Monday returns after negative return weeks are significant. Therefore, the twist-of-the-Monday effect seems to be present in indexes but not in individual stocks.

⁴ This result is not consistent with that of Costa Jr. and Lemgruber (1993) probably due to the inclusion of the most recent period returns.

⁵ Tests for individual securities are not reported here but are available upon request.

The presence of the anomaly in indexes results less as an occurrence of the anomaly in the individual securities making up the index and more due to the combination of securities in the index. Campbell, Lo, and McKinley (1997) stated that anomalies may appear in indices without necessarily being present in the securities that make them up. This is explained by the fact that individual returns incorporate unsystematic conditions ("idiosyncratic noise"). These unsystematic conditions are attenuated when a portfolio is created. Thus, the anomaly is due to systematic components. Jaffe et al. (1989) state that indexes show autocorrelation due to non-synchronous trading in its individual stocks that leads researchers to identify this anomaly while it is not present in the individual stocks.

It may be that the three stocks presenting the anomaly could be responsible for the occurrence of the anomaly in the index. For example, Paranapanema PN and Petrobrás PN are two of the stocks that present the anomaly and they accounted for approximately 40% of the IBOVESPA in 1988. However, the relatively high weight of these stocks is not sufficient to explain the phenomenon as it decreases substantially towards the end of the sample period. Moreover, it cannot explain the anomaly in the equally weighed index.

In order to determine if these three stocks are truly influencing the results for index, the following test was undertaken: the liquidity weighed index was redefined to eliminate the three stocks showing the anomaly. The index continued to present the twist-of-the-Monday effect even after removing these stocks. It can be concluded that the presence of the anomaly in the IBOVESPA during the 1986-1998 period is not due to its occurrence in three individual stocks⁶.

4 SUB-PERIOD ANALYSIS

In this exercise we used the three indexes and the three stocks that presented the anomaly over the whole period. The original sample period was divided into three arbitrary sub-periods: (1) 1/1/1986 to 12/31/1989; (2) 1/1/1990 to 12/31/1993; and (3) 1/1/1994 to 6/2/1998. The statistical tests applied to the overall period were repeated for each sub-period. Table 6 presents the results.

For the IBOVESPA and the most liquid stocks weighed index, the anomaly appears only in the earlier period. For the equally weighed index, the anomaly is present in the earlier period, absent in the intermediate period and, surprisingly, returns in the most

⁶ This test is not reported here but is available upon request.

recent period⁷. However, the Wilcoxon test suggests that the returns on Mondays following weeks of negative returns are still significantly lower those following weeks of positive returns. The Spearman test shows that Monday returns remain significantly related to the previous week returns.

5 TRADING STRATEGY

The evidence so far suggests that one could devise an investment trading strategy to profit from the anomaly by using a portfolio of the most liquid stocks. The strategy consists of not holding securities on a Monday when the return of the previous week was negative. The investor remains invested on Mondays following a week of positive returns and is out of the market on the Mondays of weeks following negative returns. This strategy is conservative because it simply avoids investing on Mondays following a week of negative returns altogether. Alternately, the investor could short on Mondays or invest in the money market.

The actual average daily return on Mondays for the IBOVESPA in the 1986-1998 period is -0.12%. Ignoring transaction costs, if one does not invest in the IBOVESPA following weeks of decline, assuming a null return rather than the actual return in those Mondays, the average return for all of the Mondays in the same period would then be 0.27% per day.

This trading strategy can be compared to a buy and hold strategy in the same period. The investment strategy based on the anomaly consists of investing in the IBOVESPA unless the Monday in question follows a week of decline. The strategy return for all Mondays following weeks of decline is zero. In the passive strategy, the daily return is always the actual IBOVESPA return. Table 7 compares the results of these two strategies. The accumulated effect over the period is significant. The strategy that takes the anomaly into consideration yields 8 times more than the passive strategy and is slightly less risky.

One of the difficulties of effectively applying this strategy using the IBOVESPA is the number of stocks that make up the index. In order to obtain the exact return of the index, it is necessary to invest in all securities in the index. We computed two alternate indexes with a substantially reduced number of stocks, varying between 10 to 13, one is weighed

⁷ Each of the three individual stocks presenting the twist-of-the-Monday effect showed the anomaly in the earlier period and not in the most recent period. These tests are not included here.

proportional to the original IBOVESPA and the other is equally weighed. The trading strategy was applied to each index and yields 5 times more than the buy and hold strategy for the weighed index and 4 times more for the equally weighed index. Table 7 depicts these results.

6 SUMMARY AND CONCLUSIONS

This paper analyses the anomaly known as the twist-of-the-Monday effect in the Brazilian stock market for the IBOVESPA index as well as indexes obtained from the most liquid IBOVESPA stocks and for individual stocks in the 1986-1998 period. In the whole sample period, the index results suggest the presence of the anomaly. However, when sub-periods are taken into account, the anomaly shows in the earlier period and disappears in the most recent periods. The results for individual stocks also indicate that the anomaly is significant only for 3 of the 44 securities analyzed. Moreover, we found that these 3 stocks were not responsible for the twist-of-the-Monday effect in the indexes. We also did not detect significantly negative returns for all Mondays, or the Monday effect. However, Monday returns remain correlated with the previous week returns and are significantly different when grouped according to the previous week returns. Forming a portfolio with the most liquid stocks and following a trading strategy could still be profitable.

We verify the consistency of the twist-of-the-Monday effect for the other days of the week and find that it is only present on Mondays. We also verified that the anomaly does not occur due to a correlation between Monday and Friday returns. Although this correlation is highly significant, the phenomenon persists even when we exclude the Friday returns from the previous week. We also observed that the negative return on Monday after a decline in the market actually occurs during the weekend period between the closing of the market on Friday and the opening of the market on Monday. Moreover, Monday intraday returns are significantly positive. Thus, we actually have a “twist-of-the-weekend effect”.

We investigated the anomaly’s practical financial implications through the simulation of a trading strategy that consists of not holding the stocks in the index on the Mondays following a week declining returns. Ignoring transaction costs, this investment strategy, if applied in the IBOVESPA between 1986 and 1998, would yield 8 times more than a buy and hold strategy. Considering only the most liquid stocks in the index the strategy would yield 5 times more in a trading volume weighed portfolio and 4 times more in for an equally weighed portfolio.

We also performed an out of the sample test for the 6/2/98 to 5/21/99 period, using only the equally weighed index for ten liquid stocks. Additionally, we used the close of Monday to close of Thursday return as the previous week return. The average return on Mondays following previous weeks with declining returns was -3.67% . The average return for Mondays following previous weeks with rising returns was 6.23% . This is the average return of our trading strategy. A buy and hold strategy in the period would have earned -1.32% and would have been riskier. Naturally, a trading strategy past results must be taken with caution.

Researchers investigating anomalies in emerging markets, and other markets, should try to use individual stocks in their tests. Index construction methods seem to produce effects that are observable only for the index portfolio and not for its individual components. Moreover, these effects do not seem to be consistent in time.

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8 ANNEX

Table 1

Selected Day of the Week Anomaly Studies Including the Brazilian Stock Market

Weekend effect			
Study	Period	Method	Results
Lemgruber et al. (1988)	1983-87	IBV and IBOVESPA indexes and regression analysis for calendar and trading days	Lower returns on Mondays
Costa Jr. (1990)	1986-89	IBOVESPA index and regression analysis	Significant lower returns on Mondays
Costa Jr. & Lemgruber (1993)	1986-89	Equally weighted and value weighted indexes from eighty-three stocks	Significant lower returns from open to close on Mondays
Almeida et al. (1993)	1983-90 IBV index 1978-90 IBOVESPA index	Daily nominal and inflation adjusted returns on the IBOVESPA and IBV indexes and t-tests and regression analysis	Significant lower returns on Mondays
Agrawal & Tandon (1994)	1972-88	IBV index and regression analysis	Significant lower returns on Mondays
Leal & Sandoval (1994)	1982-93	IBOVESPA index and non-parametric tests	Significant lower returns on Mondays
Aggarwal & Leal (1996)	1982-91	IBOVESPA index and regression analysis	Significant lower returns on Mondays

Twist-of-the-Monday effect			
Agrawal & Tandon (1994)	1972-88	IBV index and regression analysis	Significant evidence
Leal & Sandoval (1994)	1982-93	IBOVESPA index and non-parametric tests	Significant evidence
Aggarwal & Leal (1996)	1982-91	IBOVESPA index and regression analysis	Significant evidence

Table 2

Median day of the week returns following positive or negative previous week returns for the IBOVESPA index and two indexes obtained with the most liquid stocks in the IBOVESPA in the 1986-1998 period. A sign test is applied to two sub-samples containing the days following weeks of rising returns and days following weeks of declining returns. The significance level indicates if the returns are different from zero. The Chi-square and Wilcoxon tests indicate if the sub-samples are different. The Spearman test presents the coefficient of correlation between the sign of the each day return and the sign of the previous week return. All returns are percentages. The asterisk indicates significance at the 5% level.

	IBOVESPA Index					Most Liquid Index Monday Return	
	Mon	Tue	Wed	Thur	Fri	Weighted	Equally Weighed
Previous Week Positive	.3*	.4*	.3*	.9*	.8*	.4*	.1
Previous Week Negative	-1.1*	1.2	.8	.8	.3	-1.0*	-.8*
Chi Square	14.03*	2.90	2.47	0.04	1.08	10.04*	7.51*
Wilcoxon	-4.60*	-1.23	-0.49	-0.02	-0.60	-4.33*	-3.89*
Spearman	0.20*	-0.06	-0.02	0.00	0.03	0.20*	0.18*

Table 3

Median day of the week returns following positive or negative previous week returns for the IBOVESPA index and two indexes obtained with the most liquid stocks in the IBOVESPA in the 1986-1998 period. The previous week's return for Tuesday is computed from the previous Tuesday to the prior Monday and so on. A sign test is applied to two sub-samples containing the days following weeks of rising returns and days following weeks of declining returns. The significance level indicates if the returns are different from zero. The Chi-square and Wilcoxon tests indicate if the sub-samples are different. The Spearman test presents the coefficient of correlation between the sign of the each day return and the sign of the previous week return. All returns are percentages. The asterisk indicates significance at the 5% level.

	IBOVESPA				Most Liquid Weighed				Most Liquid Equally Weighed			
	Tue	Wed	Thur	Fri	Tue	Wed	Thur	Fri	Tue	Wed	Thur	Fri
Previous Week Positive	.7*	.7*	1.1*	.7*	.7*	.7*	1.0*	.7*	.6*	.6*	.9*	.5*
Previous Week Negative	.6	.4	.4	.5	1.0	.3	.4	.4	.9	.5	.6	.5
Chi Square	.01	1.29	2.36	0.17	.13	1.69	.28	.48	.52	.02	.66	.00
Wilcoxon	-.55	-2.47	-2.62	-.56	-.28	-2.20*	-1.53	-.05	-.34	-1.26	-1.76	-.82
Spearman	.02	.10*	.11*	.02	-.01	.10*	.07	.00	-.02	.06	.08	.04

Table 4

Median Monday returns following positive or negative previous week returns defined in two different ways in the 1986-1998 period. The indexes are (1) the IBOVESPA, (2) the most liquid stocks weighed index, and (3) the most liquid stocks equally weighed index. A sign test is applied to two sub-samples containing the days following weeks of rising returns and days following weeks of declining returns. The significance level indicates if the returns are different from zero. The Chi-square and Wilcoxon tests indicate if the sub-samples are different. The Spearman test presents the coefficient of correlation between the sign of the each day return and the sign of the previous week return. All returns are percentages. The asterisk indicates significance at the 5% level.

Previous Week Return Definition	Monday close to Friday Open			Friday open to Friday close		
	(1)	(2)	(3)	(1)	(2)	(3)
Previous Week Positive	.7*	.7*	.7*	.3*	.4*	.3
Previous Week Negative	-1.3*	-.9*	-.9*	-.6*	-.9*	-.8*
Chi Square	23.94*	14.89*	23.84*	5.54*	10.91*	10.09*
Wilcoxon	-6.54*	-4.81*	-6.06	-2.95*	-3.67*	-3.72*
Spearman	.28*	.21*	.26*	.13*	.17*	.17*

Table 5

Median Monday returns following a week of declining returns. Monday returns were defined in three different ways: close of Friday to close of Monday; close of Friday to Monday open and Monday open to Monday close for the IBOVESPA index and two indexes obtained with the most liquid stocks in the IBOVESPA in the 1986-1998 period. A sign test was applied. The significance level indicates if the returns are different from zero. All returns are percentages. The asterisk indicates significance at the 5% level.

		Most Liquid Stocks Index	
	IBOVESPA	Weighed	Equally Weighed
Close of Friday to Monday Close	-1.1*	-1.0*	-.8*
Close of Friday to Monday open	-1.0*	-1.5*	-.5*
Open of Monday to Monday close	1.0*	.8*	.7*

Table 6

Median Monday returns following positive or negative previous week returns in three sub-periods: Jan/86 to Dec/89, Jan/90 to Dec/93 and Jan/94 to Jun/98. The indexes are (1) the IBOVESPA, (2) the most liquid stocks weighed index, and (3) the most liquid stocks equally weighed index. A sign test is applied to two sub-samples containing the days following weeks of rising returns and days following weeks of declining returns. The significance level indicates if the returns are different from zero. The Chi-square and Wilcoxon tests indicate if the sub-samples are different. The Spearman test presents the coefficient of correlation between the sign of the each day return and the sign of the previous week return. All returns are percentages. The asterisk indicates significance at the 5% level.

	Jan-86 to Dec-89			Jan-90 to Dec-93			Jan-94 to Jun-98		
Index	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Previous Week Positive	.4	.5	-.1	.5*	1.0*	.8	.3*	.2*	.03*
Previous Week Negative	-3.5*	-3.1*	-3.5*	-1.3	-.9	-.4	.0	-.2	-.5*
Chi Square	11.89*	8.77*	2.57	1.42	1.10	.27	1.19	.34	4.93*
Wilcoxon	-4.1-	- 3.31*	- 2.60*	- 1.99*	-1.80	-1.86	- 2.02*	- 2.17*	-3.01*
Spearman	.33*	.19*	.22*	.15*	.15	.15	.14*	.16*	.22*

Table 7

Comparing a buy and hold strategy with a trading strategy based on the anomaly for the IBOVESPA index and two indexes obtained with the most liquid stocks (weighed and equally weighed) in the 1986-98 period. All returns are percentages.

	Average Return	Std. Deviation	Final Amount ratio of \$1 Investment in 1986 in the strategy over B&H
IBOVESPA			
Buy and hold	.65	3.75	
Strategy	.72	3.63	8.2
Most Liquid Weighed Index			
Buy and hold	.63	4.41	
Strategy	.68	4.30	5.2
Most Liquid Equally Weighed Index			
Buy and hold	.69	5.18	
Strategy	.74	5.09	4.1

Figure 1
Median returns for weekdays according to the previous week return
(IBOVESPA, 1986-1998)

