LISBON
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MASTER

FINANCE

MASTER´S FINAL WORK

DISSERTATION

AN EXAMINATION OF THE WEEKEND AND HOLIDAY EFFECT IN THE S&P 500

JOÃO SERRANO RIBEIRO FONTÃO NOGUEIRA

NOVEMBER – 2020

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SUPERVISION

PROFESSOR PEDRO RINO VIEIRA

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Resumo

Utilizando informação da Reuters sobre os preços de abertura e fecho do Índice Standard & Poor's 500 (S&P500), esta dissertação visa entender se um efeito fim de semana ou feriado neste índice ocorre de forma contínua, ou se resulta de momentos específicos no tempo ou no ano. Os resultados obtidos mostram que o efeito fim de semana ocorreu durante o período de mercado aberto e desapareceu após 1988. A evidência suporta a validade do efeito feriado apenas no dia anterior ao feriado da Sexta-feira Santa. A evidência demonstra que o efeito de feriado neste índice e durante este período não se verificou nos restantes feriados. Algumas evidências foram encontradas que suportam a validade do Indicador de Halloween, onde retornos acima do normal são esperados de novembro a abril.

PALAVRAS-CHAVE: Finanças Comportamentais; Anomalias de Calendário; Efeito de Fim de Semana; Efeito de Feriado; Efeito de Segunda-feira

JEL Codes: G1; G14; G4; G40; G41.

Abstract

Using Standard & Poor's 500 (S&P500) opening and closing price data from Reuters, this dissertation aims to understand if a weekend or holiday effect in this index is happening continuously, or if it results from specific moments in time or the year, to understand this phenomenon's drivers better. The results obtained show that the weekend effect happened during trading time and vanished after 1988. The holiday effect is shown to be present on the day preceding the Good Friday holiday and absent for the rest of the holidays. Some evidence was found supporting the Halloween Indicator validity, where above-normal returns are expected from November to April.

KEYWORDS: Behavioral Finance; Calendar Anomalies; Weekend Effect; Holiday Effect; Monday Effect.

JEL Codes: G1; G14; G4; G40; G41.

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AN EXAMINATION OF THE WEEKEND AND HOLIDAY EFFECT IN THE S&P 500

By João Nogueira

1. Introduction

An above or below average return around the weekends and before holidays is documented and studied in multiple works. The main purpose of this study is to understand if these two effects are present in the S&P500 index from 20 September 1982 to 30 September 2020. Additionally, the analysis aims to understand if any of the effects are happening as a rule of tendency in price direction or result from sporadic observations, such as specific years, months, or holidays.

In sum, for the weekend effect, the analysis determines if below-average returns are reported on Mondays, above-average returns are reported on Fridays, and if any relevant movement is being caused during the non-trading weekend. For the holiday effect, the analysis determines if there is a tendency to above-average returns during pre-holiday days for all holidays as a group and individually.

The data used consists of daily prices, for both the opening and closing of the session, from the Standard and Poor's 500 Index (S&P 500), for the period between 20 September 1982 to 30 September 2020. Hence, the data is restricted to large-capitalization companies from the United States and one of the world's most actively traded indexes.

This study differs from the previous work in the scope used for analyzing the anomaly. Instead of using only the aggregated data from each group to see if an anomaly is present, the data is segregated to help spot any possible anomaly.

Section 2 of this paper relates to the literature review in calendar irregularities in general, and 2 sub-sections focusing on each of the effects in detail. Section 3 will follow with a general description of how the analysis is done in section 4 and the methodology used when working with the data. Section 5 consists of a conclusion summing the most relevant findings and contributions to the different papers mentioned in section 2.

2. Literature Review

2.1. Calendar irregularities

Whether the market is efficient[1] remains a debate with many arguments for and against it. This inconsistency might be due to the timing of analysis, capturing brief moments of efficiency or the opposite. However, the presence of anomalies has always put the arguments of market efficiency to the test. Out of the 3 main types of market anomalies (Fundamental Anomalies, Technical Anomalies, and Calendar Anomalies), this paper will focus on Calendar Anomalies.

Calendar Anomalies can be described as any market behavior that appears somehow to be related to the calendar. One of the most popular is the "January Effect" this hypothesis postulates that securities prices tend on average to increase more in January than in any other month. Multiple studies (e.g. Rendon and Ziemba, 2007; Haug and Hirschey, 2006) in this matter suggest this anomaly affects mostly small stocks. There have been many attempts at justifying this behavior, such as the tax-loss selling hypothesis (e.g. D'Mello et al., 2003), which argues that the worst-performing securities are sold to realize capital losses intentionally. This behavior should result in oversold securities, which should be repurchased in the following month. However, this might not be more than a good guess or just a small factor between many. As Haug and Hirschey (2006) suggest, the effect persists in countries with different tax years and countries with no capital gains tax. In the same study, Haug and Hirschey (2006) suggest the "window dressing" effect as one possible factor driving this anomaly. This term describes the behavior of professional investors who might eliminate embarrassing losers and risky equity before the end of important reporting periods.

The list of possible drivers is too large to do a complete summary and probably not the most interesting part of the phenomenon. The effect was first mentioned in Wachtel (1942). This study reports small stocks outperforming the broader market since 1925 during January, with most of the disparity usually occurring before the middle of the

[1] Market efficiency concerns the degree to which stock prices reflect the information available about it and is characterized by the general absence of arbitrage opportunities (Fama, 1970).

month. According to the arbitrage theory (Pompian, 2012), anomalies should cease to exist once noticed due to savvy investors exploiting such opportunities. However, we continue to see studies (e.g. Kumar, 2018; Urquhart and McGroarty, 2014; Floros and Salvador, 2014) presenting evidence of the phenomenon in different markets.

Another popular calendar anomaly known as the "Turn of the Month Effect" identifies higher returns on the last and the first 4 trading days of any month relative to the rest of the days. In accordance with the January effect, some authors (e.g. Sharma and Narayan, 2014) present evidence supporting the hypothesis that the effect is more pronounced in small-sized firms.

After analyzing this effect from 1963 to 1981, Ariel (1987) deepens the phenomenon by presenting evidence backing his following statement: "stocks appear to earn positive average returns only around the beginning and during the first half of calendar months, and zero average returns during the second half." Hensel and Ziemba (1996) have also shared their valuable insight after analyzing the S&P500 from 1928 to 1993 and stating that "the total return from the S&P 500 over this sixty-five-year period was received mostly during the turn of the month." The list of authors who have studied this phenomenon is not short as the list of suggested factors that might be causing it. Multiple authors (e.g. Ogdan, 1980) try to explain this effect by relating it to cash flows happening around the end of the month (salaries, dividends, principal payments, credit cards, mortgages, etc.).

A third effect that has been fairly studied is called the "Santa Claus Rally". This anomaly refers to a general rise in stock prices during the last 5 trading days in December and the first 2 of January. His timing intertwines with the previous 2 mentioned calendar-effects hence the difficulty of distinguishing them in the analysis. Yale Hirsch first mentioned the effect in his book "The Stock Trader's Almanac", published in 1972.

Most of the anomalies mentioned so far appear to have explanations. However, one can always find anomalous results that might be nothing more than the result of chance. Possibly, a good example of this is an observation recorded on the 2005 version of the previously mentioned book, which states that the S&P500 has advanced every year that ends with a 5 since 1885. This result is certainly impressive, and a probable

explanation of any calendar anomaly has never proved to be the definitive answer to the question. However, to take investment advice from a seemingly random calendar-anomaly might turn out to be as risky as betting on a coin toss.

Finally, so that one can grasp this field's spectrum, an enigmatic calendar-effect that has been studied is the correlation between the stock market and the lunar phase. The moon stage's impact has been studied since ancient times and for many different aspects, but it was first related to the stock market in Yuan et al. (2001). After analyzing a portfolio composed of indexes from 48 countries (developed and emerging economies) and combining the daily return of this portfolio to the 4 different stages of the moon (new moon, first quarter, full moon, and last quarter), the authors reach the following conclusion: "Strong global evidence indicates that stock returns are lower on days around a full moon than on days around a new moon." Dichev & Janes (2003) also found strong lunar effects on the stock market after analyzing "all major U.S. stock indexes over the last 100 years and for nearly all major stock indexes of 24 other countries over the last 30 years." However, after analyzing the Dow Jones Industrial Average (DJIA), Anthony (2007) defends that "no consistent, predictable lunar influence is found on either daily returns or daily price volatility in the Dow Jones Industrial Average". Even though there are some hypotheses attempting to explain this behavior, it is not easy to find solid scientific evidence behind them. Yuan et al. (2001) relate the moon stage to the investor's mood, which is difficult to assess, if not impossible.

2.2. Weekend effect

The Weekend effect (also known as the Monday effect) consists of the anomaly observed and studied where returns below the average, sometimes consistently negative, are recorded on Mondays. Some authors (e.g. Kumar, 2018; Anwar and Mulyadi, 2012) report that returns above the average occurring on Friday's are tied to this effect.

A reasonable explanation for this behavior would be that the anomaly is somehow related to the process of generating stock returns. French (1980) tested both the calendar time hypothesis and the trading time hypothesis. The calendar time hypothesis is characterized by a process that operates continuously. Monday would represent the

weekend's aggregate return and the day itself corresponding to an expected return three times the expected return for other days of the week. According to the trading time hypothesis, the returns are generated during active trading only and should be the same for each day of the week. After testing both on the S&P from 1953 to 1977 and observing average positive returns from Thursday to Friday and significantly negative average returns for Monday, the conclusion was that both models are inconsistent with reality. Several researchers have suggested that both individual (e.g. Abraham and Ikenberry, 1994; Dyl and Maberly, 1992; Lakonishok and Maberly, 1990; Miller, 1988) and institutional investors (Brockman and Michayluk, 1998; Hindmarch et al., 1984; Sias and Starks, 1995) may drive the weekend effect. Even though both sides can be contributing to the anomaly, it is interesting to see the drivers that support both assumptions.

Rogalski (1984) decomposed the Monday return into 2 segments to study how the non-trading weekend affected the average Monday return. Calculating the average return from Friday close to Monday open and the average return from Monday open to Monday close, he finds that most of the negative return from Friday close to Monday close happens precisely during the weekend when the market is closed. Rogalski also finds that the Monday effect ceases to exist in January, where other relations to the returns appear, such as the firm size, suggesting that the January effect dominates the weekend effect.

Looking at 15-minute time intervals, Harris (1985) shows that "(...) significant weekday differences in intraday returns accrue during the first 45 minutes after the market opens. On Monday mornings, prices drop, while on the other weekday mornings, they rise." However, analysis of a time interval of this size poses some challenges. As he concluded, the 14-month time-series sample analyzed is not sufficient to determine whether the patterns are stationary, non-stationary, or seasonal.

Some papers (e.g. Keim and Stambaugh, 1984) have presented evidence suggesting a positive correlation between Friday's returns and Monday's return. Abraham and Ikenberry (1994) backed this argument by showing that Monday's return is negative 80% of the time that Friday's return is also negative.

Wang et al. (1997) document that the Monday effect is mostly caused by the last 2 weeks of the month during the 1962 to 1993 period. This finding raises the question of the weekend effect being partially affected by the turn-of-the-month effect.

Chen and Singal (2003) presented evidence that short-sellers behavior is one factor contributing to the weekend effect. However, by analyzing short sell activity on the Hong Kong Stock Exchange, Gao et al. (2011) conclude that a significant weekend effect exists before 1993, a period when short selling was not allowed.

Recent studies, such as Chatzitzisi et al. (2019) and Liu and Li (2010), found evidence of a reverse Monday effect where positive and statistically significant returns are observed during this weekday.

2.3. Holiday effect

The holiday effect can be described as the tendency of security prices to present above-average returns on trading days preceding holidays.

Fields (1934), one of the early studies on this matter, analyzed the DJIA from 1901 to 1932. A particularly curious finding of his work came from looking precisely at one of the most dramatic moments of any American index. From September 1929 until July 1932, during a memorable and drastic slump, the pre-holiday index was significantly higher than the average of the two adjacent days 18 out of the 21 times.

In a similar study, looking at an equal-weighted index of stocks from 1963 to 1982 and observing the days that preceded holidays, Ariel (1985) found that the mean return on such days (.529 percent) is almost ten times greater than the rest of the days (.056 percent). Considering a value-weighted index instead, this difference is almost 15 times greater. These findings are both economically and statically significant.

One of the broadest studies that have been done is from Lakonishok and Smidt (1988) using daily data from the DJIA over a 90-year period (1897 – 1986). They found that the average pre-holiday return (.219 percent) is 23 times greater than the normal daily rate of return (.0094 percent) and that 51 percent of the DJIA's capital gains during this period have occurred on pre-holiday days.

With a slightly different analysis, Fosback (1976) examined the return rates of the two trading days that precede any holiday. Looking at the S&P 500 Index from 1928 until

1975, had an investor been in the market only for the 2 days that precede any holiday, and he would have turned an initial investment of 10.000$ into 87.787$. On the other hand, if an investor did the exact opposite strategy, the 10.000$ would have become 5.855$ by the end of this period. Although this is impressive, it is important to consider that trading costs and dividend payments were not considered.

Even though the effect has been in observance for a long time, studies (e.g. Gama and Vieira, 2013; Casalin, 2018) continue to be published supporting the continuity of this effect for various markets.

3. Data and Methodology

The analysis will focus on whether the weekend and holiday effects are present in our data sample for the S&P500. The data will be analyzed with a scope that accounts for the time of the year and, when necessary, of the reporting price. This higher level of granularity hopes to identify better the possible time periods that lead to these effects (market closure, January effects...).

All the data used was obtained from Reuters, and it consists of opening and closing prices for the S&P 500 from 20 September 1982 until 30 September 2020. Even though it was intended to gather additional information before this period, there was no more information available for the opening prices. The choice to restrict the closing price data to the same period was with the interest of maintaining sound comparability between both samples.

The price change is calculated as $P\Delta_{(t+1,t)} = \frac{P_{t+1} - P_t}{P_t}$, where P_t is the initial price (in this case the previous day), and P_{t+1} is the price in the following day.

The entire analysis will have 3 sub-segments: the weekend effect with close to close price changes, the weekend effect with close to open price changes, and the holiday effect with only close to close price changes since the only days analyzed are the ones that precede holidays. For both anomalies, graphs will be presented at the beginning of each respective section, giving an insight into the data's distribution. These will be followed by tables, for the weekend effect in each sub-segment, providing further insight into the data.

The weekend effect analysis will resort to a table containing the summed variations for each month of each year, then summed variations of each year and each month along the years, and finally, the summed variations for the entire period. The summed variations will first consist of changes from closing prices to closing prices (as in closing Friday to closing Monday price change), and similar tables are used in the following section to analyze the changes from closing to opening prices (as in closing Friday to opening Monday price change) to find out if the effect occurs during market closure.

To see if exists a tendency in the direction of price change causing the effect or if it is a matter of magnitude of price changes affecting the mean, a table reporting the proportion of times the price has changed up or down for each month over the entire period will also be reported.

There were a total of 170 National holidays occurring on Monday and 66 occurring on Friday. They were taken out of the sample for the analysis since they would be false null changes. Each month's occurrences were registered on a table with the direction analysis since they can give further insight into any future study.

The Holiday effect analysis consists of the calculation of summed changes, average change, and direction move of the price change from the days that preceded each holiday. Only the traditional national holidays were accounted for.

The New Year's Day holiday coincided 5 times with Saturdays (1983, 1994, 2000, 2005, 2011), which resulted in the inexistence of this holiday for the year. The Martin Luther King, Jr. Day holiday only exists since 1998, limiting the total observations registered for this holiday to 23. Apart from these two exceptions, every holiday has 38 observations, which corresponds to the number of years in the period being analyzed.

As seen before, many holidays coincided with a Monday. In these situations, the day considered for the analysis corresponds to the Friday of the previous week.

For tables related to the data, they are as close as possible to the analysis being done with them. ANOVA, or t-tests when best suited, will be present in each segment and in the appendix to test the result's significance. All tests were done using the 12.1 version of STATA.

4. Empirical Results

4.1. Weekend Effect

The following graph (Figure 1) depicts the distribution of price change for every day of the week for both close to close and close to open price registries.

The maximum and minimum points and the median appear to be close to 0% for every day of the week regarding the price changes from close to open. Looking at the price change from close to close, the median seems to revolve around 0% as well, and the maximum and minimum values of the whiskers appear to be around 2% and -2% for every day. This difference does not come as a big surprise since the price change from close to open is contained inside the price change from close to close.

The biggest difference between each day comes by looking at the outliers, and

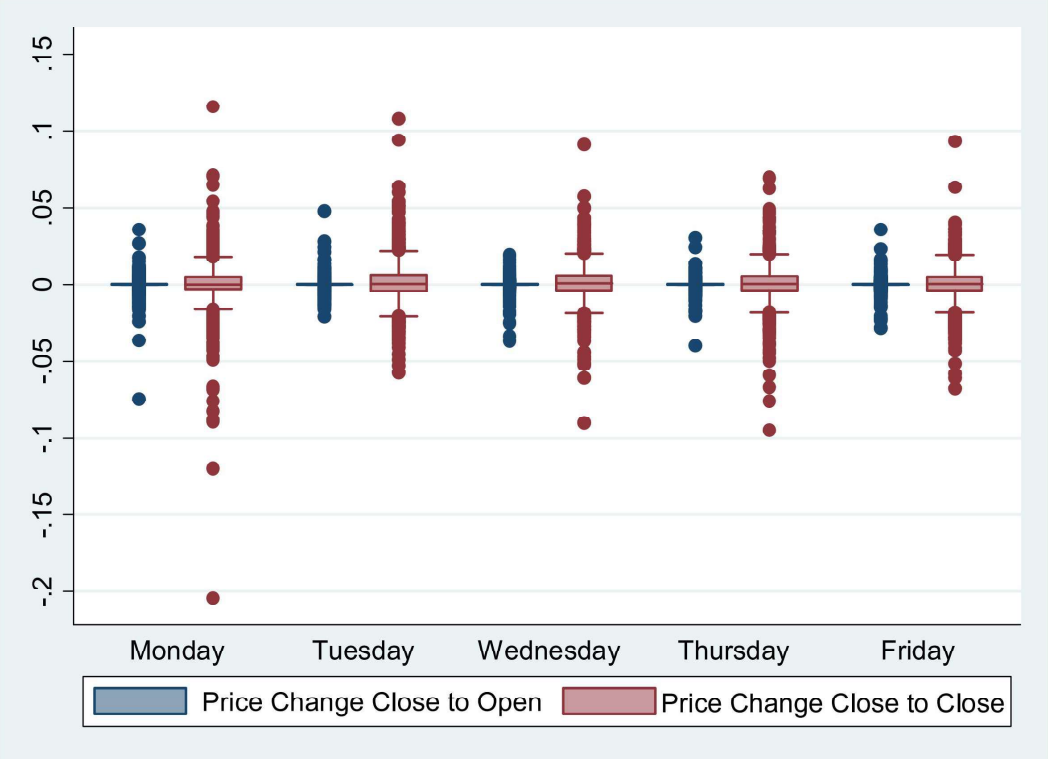

Figure 1 - Box plot of price change per day of the week

here we can see that Monday presents the largest ones. This is more pronounced on the close to close price change, where we see a registry of approximately -20% and one of more than 10%, presenting the biggest changes on both positive and negative outliers overall.

This again is not unexpected since the period of close to close and close to open from Friday to Monday, respectively, is bigger than the period between the rest of the days. Therefore, Monday is the only weekday that consistently reflects more than the information of the day itself.

The following box plot depicts the price change for a different set of groups, this time for each month.

Once again, we see no surprise on the medians for each month, all revolving around 0%. The whiskers for every box plot appear to be relatively constant, presenting similarities to the analysis done in Figure 1.

Looking at the outliers, it might be interesting to note that the summer months seem to present fewer extreme values. The 2 months that present the largest amplitude of results seem to be March and October. March has the largest amplitude of price changes from close to open, both positive and negative. Looking at price changes from

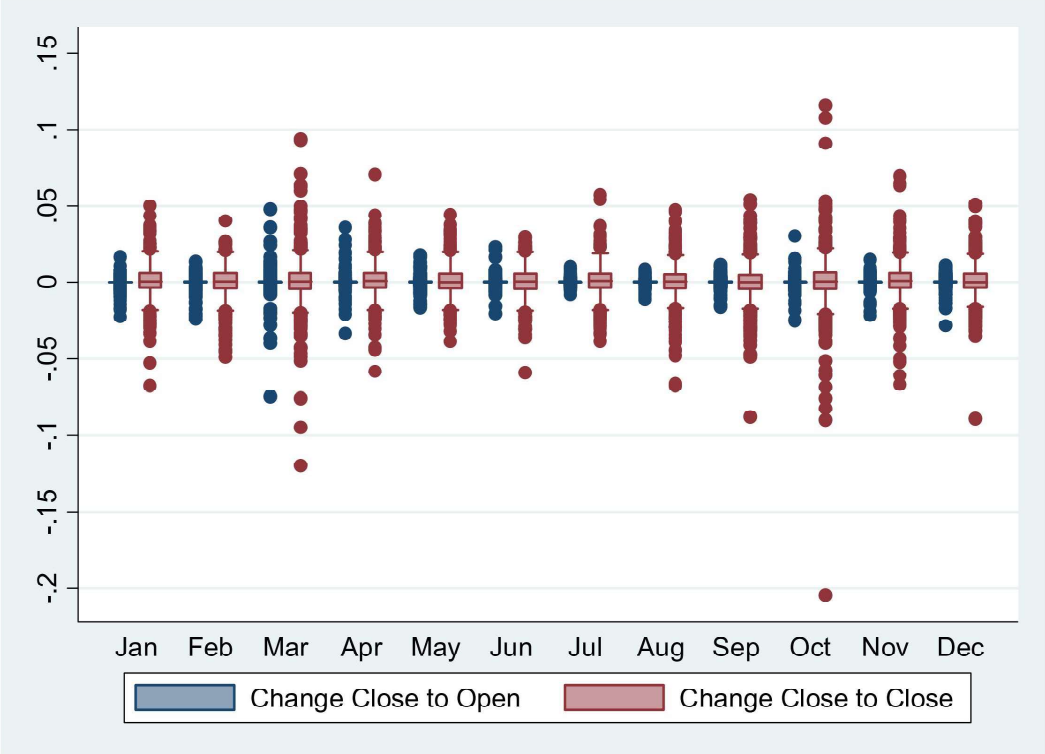

Figure 2 - Box plot of price change per month

close to close, October is the clear winner when looking at the extreme values.

It is possible to understand some of these extreme values in the next two sections and get some additional insight into the distribution.

4.1.1. Analyzing Price Change from Close to Close

As explained in Section 3 of this paper, the following table (Table 1) intends to give a granular view of the weekend effect across time to understand better which moments contribute more to the overall change for both Monday and Friday.

It is important to compare the results to the overall change of the period. From 20 September of 1982 until 30 September 2020, the S&P500 Index had a total change of 394.40%.

Focusing first on Monday's behavior, we see that it had an overall change for the period of 22,10%. Since Monday's account for about 18,92% of the total observations, it is possible to conclude that proportionally, they were not the main contributors for the growth observed. If every observation contributed equally to the overall growth, Mondays would have presented an overall summed change of approximately 74,62% (394,40%×18,92%). Nonetheless, it is not obvious that a Monday effect is present during this period.

Table 1 shows that the total change registered for Mondays is heavily impacted by the variation registered in October 1987. The second biggest Monday's monthly movement is seen in September 2008, where the month registered a total variation of -15,28% during this weekday.

Close to Close														
		Month												
Year	Weekday	January	February	March	April	May	June	July	August	September	October	November	December	SUM
1982	Monday										0,63%	-4,23%	3,36%	**-0,24%**
	Friday										2,22%	-1,57%	1,44%	**2,09%**
1983	Monday	-2,64%	0,29%	0,05%	1,16%	-1,69%	0,37%	0,79%	-0,66%	0,30%	1,39%	0,05%	0,48%	**-0,12%**
	Friday	-0,93%	1,86%	-0,49%	2,26%	0,98%	0,69%	-2,45%	1,70%	0,25%	-1,22%	0,03%	-0,24%	**2,45%**
1984	Monday	-1,59%	-1,49%	-0,62%	-0,80%	-1,07%	0,85%	0,16%	0,01%	-0,25%	-0,93%	-0,88%	1,80%	**-4,80%**
	Friday	-0,84%	0,90%	1,20%	-0,24%	-2,49%	1,23%	0,42%	3,19%	-1,86%	0,02%	-0,50%	0,02%	**1,06%**
1985	Monday	4,20%	-0,03%	-1,21%	-1,09%	1,36%	-0,76%	-2,15%	-0,59%	1,66%	0,48%	1,41%	0,15%	**3,43%**
	Friday	-0,07%	-1,26%	0,62%	-0,34%	4,17%	2,10%	1,30%	-1,54%	-0,63%	-0,65%	0,87%	2,74%	**7,31%**
1986	Monday	0,29%	1,69%	-0,18%	1,83%	1,33%	-3,54%	-6,57%	1,21%	-0,21%	-0,35%	1,01%	-1,03%	**-4,52%**
	Friday	2,43%	2,74%	0,28%	-1,98%	-0,31%	3,55%	0,75%	0,03%	-3,11%	-0,85%	2,32%	0,19%	**6,05%**
1987	Monday	3,90%	-0,89%	-3,14%	-2,01%	-0,42%	2,64%	-1,04%	1,32%	-0,08%	-29,28%	-4,63%	2,67%	**-30,97%**
	Friday	1,18%	1,49%	-0,61%	0,33%	-2,40%	0,25%	1,55%	-0,91%	0,55%	-3,06%	-3,49%	2,72%	**-2,41%**
1988	Monday	7,50%	2,05%	-0,48%	-0,13%	-0,39%	-2,08%	0,08%	-2,06%	-1,14%	-0,13%	-0,50%	1,91%	**4,62%**
	Friday	-1,38%	1,93%	-1,67%	2,20%	0,35%	0,77%	0,46%	-0,47%	3,64%	2,91%	-3,09%	0,41%	**6,05%**
1989	Monday	-0,14%	0,11%	1,68%	0,32%	0,28%	-1,47%	1,72%	0,01%	-0,64%	2,88%	-1,54%	-1,63%	**1,57%**
	Friday	1,12%	-2,34%	-1,38%	3,44%	3,98%	2,71%	2,38%	-1,07%	1,87%	-6,46%	1,40%	2,95%	**8,60%**
1990	Monday	-3,18%	0,61%	0,28%	-0,57%	2,36%	-0,56%	0,03%	1,36%	-2,41%	4,41%	3,86%	0,59%	**6,77%**
	Friday	-3,25%	-0,28%	1,50%	-2,21%	2,20%	-1,97%	-0,43%	-1,90%	1,98%	1,61%	5,14%	-0,54%	**1,85%**
1991	Monday	-2,97%	4,55%	-0,60%	-2,22%	0,05%	-3,05%	3,65%	-2,76%	0,43%	1,61%	0,26%	6,09%	**5,06%**
	Friday	1,62%	2,05%	0,94%	-1,58%	-0,42%	-0,11%	0,76%	-1,05%	-1,04%	-0,68%	-5,54%	2,79%	**-2,25%**
1992	Monday	-1,23%	1,03%	-0,20%	-0,11%	2,31%	1,86%	0,10%	-0,66%	1,72%	2,25%	0,72%	0,27%	**8,08%**
	Friday	-0,51%	-1,82%	-0,73%	0,55%	-1,26%	0,98%	-0,41%	-0,38%	-0,57%	-2,84%	0,66%	1,63%	**-4,71%**
1993	Monday	1,19%	0,85%	2,35%	0,55%	1,30%	1,10%	0,70%	1,49%	0,16%	0,11%	-0,94%	1,28%	**10,13%**
	Friday	0,06%	-0,06%	-2,20%	-2,12%	-1,68%	-0,98%	-1,48%	0,22%	0,78%	0,90%	0,98%	0,52%	**-5,06%**
1994	Monday	0,62%	0,66%	0,01%	-0,62%	-1,06%	0,19%	0,15%	0,49%	-0,24%	-0,54%	0,70%	0,37%	**0,73%**
	Friday	1,40%	-2,17%	0,14%	-0,73%	-0,98%	-1,55%	1,86%	1,71%	-2,52%	2,17%	-1,56%	1,70%	**-0,53%**
1995	Monday	0,59%	-0,32%	0,71%	0,60%	1,93%	1,12%	1,47%	0,64%	0,13%	-1,22%	-0,74%	-0,11%	**4,81%**
	Friday	0,99%	1,08%	2,12%	0,93%	-0,87%	-0,59%	-0,16%	0,12%	0,26%	0,19%	0,77%	0,92%	**5,76%**
1996	Monday	0,63%	0,35%	3,69%	0,96%	1,95%	-0,19%	-4,06%	-0,05%	1,82%	0,02%	1,59%	-0,38%	**6,32%**
	Friday	1,03%	-0,84%	-2,69%	1,19%	1,36%	0,76%	-2,15%	0,92%	3,00%	2,47%	1,53%	-0,19%	**6,39%**
1997	Monday	-0,70%	0,61%	0,67%	1,60%	4,11%	-2,06%	-0,84%	1,63%	1,16%	-4,74%	2,19%	5,47%	**9,10%**
	Friday	2,29%	0,13%	1,45%	-1,87%	2,78%	3,33%	-1,59%	-5,82%	2,16%	-0,80%	0,98%	0,45%	**3,47%**
1998	Monday	1,38%	2,35%	0,02%	-2,05%	-0,30%	-1,11%	1,37%	-5,51%	2,80%	0,67%	0,84%	-0,05%	**0,42%**
	Friday	-2,45%	1,13%	2,25%	0,51%	0,25%	1,96%	-1,13%	-3,58%	2,41%	5,55%	2,76%	3,12%	**12,78%**
1999	Monday	-0,25%	2,49%	3,33%	0,88%	-0,54%	2,22%	-1,76%	-0,04%	-0,08%	1,56%	-0,97%	-1,12%	**5,71%**
	Friday	3,31%	-3,02%	0,21%	-0,68%	-0,25%	1,65%	0,81%	1,23%	4,23%	1,53%	1,38%	2,84%	**13,24%**
2000	Monday	-0,08%	1,30%	-2,86%	2,69%	2,27%	1,03%	0,54%	3,49%	-2,47%	0,82%	-1,99%	2,30%	**7,02%**
	Friday	0,74%	-6,66%	2,65%	-5,68%	0,21%	0,79%	-0,61%	1,09%	-2,86%	3,14%	-1,42%	1,23%	**-7,39%**
2001	Monday	0,52%	3,29%	-0,84%	-2,54%	1,63%	-1,36%	-1,14%	-0,72%	-0,40%	-2,07%	2,97%	-2,56%	**-3,23%**
	Friday	-3,86%	-5,53%	-1,94%	-1,35%	-0,23%	-2,10%	-1,83%	0,75%	-1,57%	0,50%	1,23%	0,35%	**-15,56%**
2002	Monday	-1,30%	0,76%	0,77%	-3,16%	-1,41%	1,06%	-1,62%	-0,85%	-1,69%	-0,27%	-2,04%	0,58%	**-9,15%**
	Friday	-1,22%	0,50%	3,56%	-0,98%	-2,92%	-2,17%	0,88%	-4,57%	-0,97%	3,97%	0,84%	-1,02%	**-4,11%**
2003	Monday	0,49%	-0,54%	-5,09%	3,68%	-1,62%	-0,19%	0,79%	1,56%	0,30%	1,87%	1,19%	2,93%	**5,38%**
	Friday	-3,06%	2,92%	2,71%	-1,49%	4,30%	-2,11%	3,88%	-1,16%	-1,38%	-0,26%	-1,08%	-0,37%	**2,90%**
2004	Monday	2,93%	-0,17%	-1,30%	0,95%	-1,02%	0,10%	-0,10%	0,91%	-0,99%	0,97%	0,13%	0,43%	**2,83%**
	Friday	-0,98%	0,45%	0,20%	0,83%	-1,09%	0,24%	-1,31%	-0,51%	0,68%	0,48%	0,26%	-0,92%	**-1,66%**
2005	Monday	0,02%	-0,68%	0,58%	1,43%	2,49%	0,21%	-0,30%	0,87%	-0,60%	1,80%	-0,18%	-0,74%	**4,90%**
	Friday	-0,46%	2,80%	0,16%	-2,64%	-0,62%	-1,19%	1,32%	-1,91%	1,48%	3,00%	0,97%	-0,42%	**2,50%**
2006	Monday	0,67%	0,12%	-0,77%	-0,22%	-0,64%	-3,47%	2,31%	-0,02%	1,03%	0,65%	-0,02%	0,79%	**0,43%**
	Friday	0,00%	-0,32%	0,42%	-0,98%	0,89%	-0,92%	-0,66%	-0,17%	0,71%	-0,79%	-0,30%	-0,97%	**-3,09%**
2007	Monday	-0,42%	-0,55%	0,51%	0,38%	0,23%	-0,16%	2,48%	1,49%	-1,16%	0,92%	-5,56%	-1,22%	**-3,06%**
	Friday	0,05%	-0,98%	-1,46%	1,26%	2,39%	0,72%	-2,18%	2,11%	-1,51%	0,25%	1,64%	0,26%	**2,53%**
2008	Monday	3,17%	0,92%	-0,29%	-0,44%	0,74%	-0,83%	-3,65%	-3,67%	-15,28%	9,32%	2,37%	-8,58%	**-16,22%**
	Friday	-6,01%	-1,03%	-3,71%	0,51%	-1,39%	-3,81%	-0,66%	2,00%	5,00%	-5,06%	6,00%	5,18%	**-3,00%**
2009	Monday	-2,17%	-3,37%	-2,42%	-5,87%	4,27%	-2,05%	4,19%	-2,09%	2,07%	1,69%	6,06%	1,61%	**1,94%**
	Friday	0,05%	-1,81%	-3,11%	3,15%	3,01%	0,05%	-0,06%	2,15%	0,83%	-4,72%	-1,22%	1,50%	**-0,18%**
2010	Monday	2,24%	0,44%	2,12%	0,99%	4,53%	-2,12%	1,79%	0,89%	2,07%	0,15%	-0,53%	0,19%	**12,75%**
	Friday	-3,99%	0,37%	0,94%	-1,90%	-3,15%	-2,59%	-1,80%	0,52%	4,01%	1,45%	-1,28%	0,93%	**-6,47%**
2011	Monday	2,34%	1,42%	-0,21%	-1,51%	-1,53%	0,45%	-1,09%	-2,04%	2,05%	-2,56%	0,73%	-1,64%	**-3,58%**
	Friday	-0,99%	2,09%	0,72%	0,72%	-0,79%	-3,24%	1,61%	0,48%	-6,52%	2,84%	1,01%	2,46%	**0,39%**
2012	Monday	0,02%	0,77%	1,42%	-1,66%	0,53%	-2,70%	-1,09%	0,06%	-1,15%	0,77%	2,01%	2,20%	**1,17%**
	Friday	-0,84%	1,17%	0,83%	-0,89%	-2,91%	2,59%	1,61%	3,46%	0,35%	-2,06%	1,03%	-2,16%	**2,19%**
2013	Monday	-0,59%	-3,05%	-0,10%	-0,93%	0,12%	0,10%	1,03%	-1,26%	0,49%	-0,30%	-0,07%	1,06%	**-3,48%**
	Friday	1,37%	2,34%	1,24%	-0,01%	1,03%	0,53%	1,57%	-0,45%	-0,85%	2,43%	2,47%	1,56%	**13,23%**
2014	Monday	-2,00%	-1,51%	0,48%	0,45%	1,54%	0,20%	-0,11%	2,33%	-1,43%	-1,04%	0,66%	-1,58%	**-2,01%**
	Friday	-2,93%	1,90%	-0,06%	-3,01%	1,00%	1,14%	0,69%	0,99%	0,72%	3,14%	0,33%	-0,67%	**3,24%**
2015	Monday	-2,38%	0,84%	3,41%	0,71%	0,09%	-2,38%	0,22%	-3,25%	-2,52%	1,79%	1,11%	0,34%	**-2,03%**
	Friday	-1,38%	0,38%	-0,89%	-0,39%	1,66%	-1,41%	0,05%	-3,02%	-2,75%	2,58%	-0,72%	-1,67%	**-7,54%**
2016	Monday	-3,01%	-0,83%	0,12%	-0,12%	1,63%	-1,55%	0,28%	0,53%	0,61%	0,29%	2,43%	0,67%	**1,04%**
	Friday	1,26%	-0,09%	2,41%	0,31%	0,50%	-5,13%	2,25%	0,48%	-2,19%	-0,62%	-0,15%	0,12%	**-0,85%**
2017	Monday	-1,22%	0,41%	-0,59%	1,85%	1,17%	0,65%	0,14%	1,33%	1,01%	-0,33%	0,31%	0,75%	**5,48%**
	Friday	0,79%	1,40%	-0,06%	-0,58%	0,97%	0,63%	0,94%	0,30%	0,67%	1,30%	0,16%	0,68%	**7,19%**
2018	Monday	0,30%	-1,53%	2,27%	-1,90%	1,17%	-1,03%	0,69%	0,96%	-0,72%	-1,35%	-1,52%	-2,67%	**-5,32%**
	Friday	3,00%	1,01%	0,32%	-3,22%	0,95%	1,56%	0,20%	0,72%	-0,23%	-0,90%	-1,17%	-6,42%	**-4,18%**
2019	Monday	-0,61%	0,87%	1,37%	1,41%	-3,54%	0,11%	0,42%	-1,86%	0,17%	0,66%	0,98%	-0,96%	**-0,98%**
	Friday	5,59%	1,89%	-0,25%	1,59%	-0,43%	1,34%	0,40%	-2,48%	-1,00%	2,53%	1,81%	1,42%	**12,40%**
2020	Monday	-0,52%	-1,89%	-14,55%	5,71%	3,59%	4,53%	2,23%	2,05%	1,73%				**2,87%**
	Friday	-3,28%	-2,23%	-0,12%	2,56%	-0,01%	0,94%	1,48%	1,06%	-0,28%				**0,12%**
SUM	**Monday**	**6,98%**	**9,60%**	**-11,70%**	**1,93%**	**26,94%**	**-11,40%**	**-5,06%**	**4,84%**	**-13,90%**	**-7,39%**	**7,24%**	**14,03%**	**22,10%**
	Friday	**-6,57%**	**3,24%**	**3,72%**	**-12,79%**	**10,49%**	**-2,44%**	**5,81%**	**0,25%**	**6,85%**	**13,44%**	**13,84%**	**34,21%**	**70,03%**

Table 1 - Summed variations from close to close prices

Looking at the bottom of the table, we see that the total change in Mondays for May during the entire period was 26.94%. Even though this month registered an expressive total change across time, the biggest change recorded for Mondays of this month is seen in 2010, where the total change recorded is 4.53%.

It is interesting to note that by looking at the summed yearly values on the right of the table, from 1982 until 1988, there seems to be a bigger chance for a Monday effect than on the rest of the period being analyzed.

With an overall change for the period of 70%, Fridays seem to be more in line with the hypothesis of equal means across weekdays. They account for approximately 20% of all observations. Assuming equal contribution, a sum of 78,88% (394,4%×20%) should have been contributed by this weekday.

The most expressive changes, negative and positive, registered in summed Fridays for each month happened in February 2000 (-6,66%) and November 2008 (+6,00%), respectively. The month of December contributed nearly half of the overall positive change across the entire period, with a total summed change of 34,21%, and the month of April contributed the least with a total summed change of -12,79%.

The inconsistency of results here is not so evident, but the overall change for this weekday appears to give the impression of equal means across weekdays.

Looking at table 2 we get a better understanding of this case:

The top segment has the direction analysis registered in absolute terms, and the following one has the analysis done in relative terms.

Direction Analysis:

	Direction	January	February	March	April	May	June	July	August	September	October	November	December	SUM
Mondays	UP	68	69	82	88	80	82	83	95	61	93	83	85	**969**
	NULL	0	0	1	0	0	0	0	0	0	0	0	0	**1**
	DOWN	66	47	84	76	49	81	76	73	65	75	79	73	**844**
	SUM	**134**	**116**	**167**	**164**	**129**	**163**	**159**	**168**	**126**	**168**	**162**	**158**	**1814**
Fridays	UP	81	86	88	70	94	87	93	83	86	94	92	96	**1050**
	NULL	0	0	0	0	0	0	0	0	0	0	0	0	**0**
	DOWN	82	67	71	64	75	75	64	86	77	73	77	62	**868**
	SUM	**163**	**153**	**159**	**134**	**169**	**162**	**157**	**169**	**163**	**167**	**161**	**158**	**1918**

	Direction	January	February	March	April	May	June	July	August	September	October	November	December	SUM
Mondays	UP	51%	59%	49%	54%	62%	50%	52%	57%	48%	55%	51%	54%	53%
	NULL	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	DOWN	49%	41%	50%	46%	38%	50%	48%	43%	52%	45%	49%	46%	47%
	SUM	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Fridays	UP	50%	56%	55%	52%	56%	54%	59%	49%	53%	56%	56%	61%	55%
	NULL	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	DOWN	50%	44%	45%	48%	44%	46%	41%	51%	47%	44%	44%	39%	45%
	SUM	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Holidays Count	January	February	March	April	May	June	July	August	September	October	November	December	SUM
Mondays	34	38	0	0	38	0	10	0	38	1	0	11	**170**
Fridays	5	0	10	28	0	1	11	0	1	0	0	10	**66**

Table 2 – Direction analysis from close to close prices.

Looking first on Monday, the months of October and September present no expressive downwards tendency. Considering all months, the month of October is, in fact, the 4th with a higher tendency for "upward Mondays". The month of May is the one that presents the highest tendency for Mondays showing an upward movement, but it is also a month with fewer observations due to the annual presence of the Memorial Day holiday during this month.

In sum, the weekday presents 53% of upward changes against 47% of downward variations.

The following ANOVA test gives a clear indication of equality between the means of each weekday's returns.

Weekday	Summary of Price Change Close to Close		
	Mean	Std. Dev.	Freq.
Monday	0.00011553	0.01331749	1814
Tuesday	0.00076843	0.01140209	1965
Wednesday	0.00066328	0.01067658	1963
Thursday	0.00020451	0.01120106	1929
Friday	0.00027917	0.010464	1918
Total	0.00041209	0.0114316	9589

Analysis of Variance					
Source	SS	df	MS	F	Prob > F
Between Groups	0.00064991	4	0.000162478	1.24	**0.2901**
Within Groups	1.25232401	9584	0.000130668		
Total	1.25297392	9588	0.000130681		
Bartlett's test for equal variances: chi2(4) = 141.2366 Prob>chi2 = 0.000					

Table 3 - One-way ANOVA test to the difference in the means of close to close returns between weekdays

An additional t-test to the difference between the mean returns of the 2 groups, Mondays and non-Mondays, arrives at the same conclusion. This information is present in the appendix section (Table A1).

Testing the hypothesis of the effect having vanished after 1988, additional ANOVA tests to the 2 different sub-periods give additional insight.

Weekday	Summary of Price Change Close to Close		
	Mean	Std. Dev.	Freq.
Monday	-0.0010648	0.01612684	304
Tuesday	0.0012449	0.01043009	326
Wednesday	0.00143974	0.01045646	325
Thursday	0.00049278	0.01019311	318
Friday	0.00058417	0.00971337	317
Total	0.00058417	0.01159274	1590

Analysis of Variance					
Source	SS	df	MS	F	Prob > F
Between Groups	0.00121378	4	0.000303445	2.27	0.0601
Within Groups	0.21233435	1585	0.000133965		
Total	0.21354813	1589	0.000134392		
Bartlett's test for equal variances: chi2(4) = 123.6611 Prob>chi2 = 0.000					

Table 4 - One-way ANOVA test to the difference in the means of close to close returns between weekdays for the period from September 1982 to December 1988

Weekday	Summary of Price Change Close to Close		
	Mean	Std. Dev.	Freq.
Monday	0.00035316	0.0126699	1510
Tuesday	0.00067366	0.01158634	1639
Wednesday	0.00050922	0.01071617	1638
Thursday	0.0001476	0.01139157	1611
Friday	0.00019574	0.010607	1601
Total	0.00037788	0.0114316	7999

Analysis of Variance					
Source	SS	df	MS	F	Prob > F
Between Groups	0.00064991	4	0.000162478	0.60	0.6638
Within Groups	1.25232401	7994	0.000130668		
Total	1.25297392	7998	0.000130681		
Bartlett's test for equal variances: chi2(4) = 64.9039 Prob>chi2 = 0.000					

Table 5 - One-way ANOVA test to the difference in the means of close to close returns between weekdays for the period from January 1989 to September 2020

The ANOVA test done to the first period supports the hypothesis, revealing a negative average return for Mondays and a statistically significant difference in the means of returns between weekdays. The second test shows no statistically significant difference in the means of returns from January 1989 until September 2020, confirming the preliminary result. Like in the analysis done for Table 3, t-tests to the 2 groups in analysis for the 2 sub-periods have provided similar conclusions. It is possible to see this information in Table A2 and Table A3 of the appendix.

Recalling Table 2 and Looking now at the case of Friday's, we see a slightly higher tendency for upward movements. Fridays presented a total tendency of 55% for an upward movement and 45% for a downward change. The only month with a downward

tendency above 50% was August, and the month with the highest upward tendency is December, which goes in line with the observations done when analyzing Table 1.

The results obtained in Table 3 support the hypothesis of equal means between Friday's and the rest of the weekdays.

Additional t-tests for the 2 subperiods mentioned on the Monday analysis were also done to analyze a possible Friday effect, but they did not show any statistically significant results. They can be seen in Table A4 and Table A5 of the Appendix section.

An analysis of the impact of Friday's movement on the following Mondays will end this segment. With a similar approach to the study done by Abraham and Ikenberry (1994), the data reveals Mondays being negative 46% of the time when Fridays presented a downwards direction. When facing a positive price change on Fridays, Mondays presented positive movements 53,77% of the time. The relation between the 2 variables is significant at a 5% level, and the correlation level is 5,1%, revealing a low dependence.

4.1.2. Analyzing Price Change from Close to Open

Table 6 and Table 7 present an identical format to the ones shown before, with the difference of the Fridays results being slightly deemed. This was done because the idea to analyze price changes from close to open is to understand if a possible Monday effect is being caused during the non-trading weekend, and not if any positive movement during Friday's is happening between Thursday to Friday market closure.

The choice to leave Friday's results was to maintain uniformity in table structures between analysis with the advantage of clarifying any reader curious about this period.

At first sight, there was an increment in investment decisions done during market closure around the year 2000 for both weekdays. This might result from an incremental use of personal computers that allowed these decisions to be made at extraordinary hours or from different time zones.

For this reason, the change in prices reported during the period from September 1982 to December 1988, previously identified with the presence of a Monday effect, is clearly being done during open market hours.

Close to Open														
		Month												
Year	Weekday	January	February	March	April	May	June	July	August	September	October	November	December	SUM
1982	Monday										0,03%	0,00%	0,00%	**0,03%**
	Friday										0,00%	-0,01%	0,00%	-0,01%
1983	Monday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	**0,00%**
	Friday	0,01%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	-0,01%	0,00%	0,00%	0,00%	0,00%	0,00%
1984	Monday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	**0,00%**
	Friday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
1985	Monday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	-0,01%	0,00%	0,00%	0,00%	**-0,01%**
	Friday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,24%	0,24%
1986	Monday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	**0,00%**
	Friday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
1987	Monday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	**0,00%**
	Friday	0,00%	0,00%	0,00%	0,00%	-0,18%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	-0,19%
1988	Monday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	**0,00%**
	Friday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	-0,03%	0,00%	0,00%	0,00%	0,00%	-0,03%
1989	Monday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,01%	0,00%	0,02%	**0,03%**
	Friday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%
1990	Monday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	**0,00%**
	Friday	0,00%	0,00%	-0,01%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	-0,01%
1991	Monday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	-0,01%	-0,01%	-0,02%	**-0,03%**
	Friday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	-0,05%	0,00%	0,00%	0,00%	-0,05%
1992	Monday	-0,03%	0,00%	0,00%	0,00%	0,01%	0,00%	0,00%	-0,02%	-0,07%	-0,02%	-0,68%	0,17%	**-0,64%**
	Friday	0,01%	0,00%	0,01%	-0,01%	0,01%	0,01%	0,00%	0,01%	0,00%	0,01%	0,22%	-0,15%	0,10%
1993	Monday	0,04%	0,00%	0,44%	0,01%	0,00%	0,00%	-0,01%	0,02%	0,00%	-0,02%	0,00%	0,00%	**0,47%**
	Friday	-0,02%	0,00%	0,01%	0,00%	0,06%	-0,01%	-0,04%	0,00%	0,00%	0,04%	0,00%	0,01%	0,05%
1994	Monday	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,06%	0,01%	0,00%	0,00%	0,07%	-0,01%	**0,13%**
	Friday	0,02%	-0,01%	-0,01%	0,00%	-0,04%	-0,10%	0,16%	0,00%	0,01%	-0,03%	-0,02%	0,01%	-0,01%
1995	Monday	0,14%	0,03%	0,00%	-1,38%	0,01%	0,02%	0,03%	0,01%	0,03%	-0,04%	0,01%	0,00%	**-1,13%**
	Friday	0,03%	-0,03%	-0,03%	0,03%	-0,43%	0,03%	-0,01%	0,04%	0,00%	-0,01%	-0,01%	0,39%	0,01%
1996	Monday	0,00%	0,01%	0,02%	0,03%	0,00%	0,00%	0,00%	0,10%	0,00%	0,00%	0,01%	0,05%	**0,21%**
	Friday	0,01%	0,01%	0,00%	0,00%	0,02%	0,00%	-0,03%	0,00%	0,01%	-0,01%	0,00%	0,00%	0,00%
1997	Monday	0,01%	0,00%	0,00%	0,00%	0,00%	0,00%	0,00%	0,04%	0,03%	0,12%	0,00%	0,00%	**0,21%**
	Friday	0,04%	0,09%	0,00%	-0,07%	0,00%	0,00%	0,00%	0,00%	0,00%	-0,05%	-0,25%	0,00%	-0,24%
1998	Monday	0,02%	0,15%	0,04%	0,00%	0,01%	0,03%	0,02%	0,01%	0,06%	0,08%	0,06%	0,11%	**0,58%**
	Friday	0,04%	0,00%	0,00%	-0,02%	0,00%	0,00%	0,00%	0,01%	0,00%	0,01%	-0,01%	0,02%	0,05%
1999	Monday	0,22%	0,15%	0,36%	-0,24%	0,12%	0,03%	-0,11%	0,07%	0,23%	0,03%	-0,17%	0,26%	**0,94%**
	Friday	-0,12%	-0,13%	0,09%	-0,04%	-0,09%	0,07%	0,23%	0,22%	0,34%	0,32%	0,28%	0,95%	2,13%
2000	Monday	0,31%	0,19%	0,33%	0,03%	0,30%	0,16%	-0,20%	0,26%	0,17%	0,24%	-0,40%	0,50%	**1,90%**
	Friday	0,17%	0,07%	0,78%	0,11%	-0,30%	1,00%	0,29%	0,17%	-1,44%	0,07%	0,11%	0,85%	1,88%
2001	Monday	-0,53%	-0,04%	0,13%	0,00%	0,00%	0,15%	-0,04%	-0,24%	0,00%	-0,99%	0,93%	-0,73%	**-1,37%**
	Friday	0,24%	-1,20%	0,38%	-0,07%	0,00%	0,04%	-0,04%	-0,43%	0,10%	-1,36%	-0,08%	-0,02%	-2,45%
2002	Monday	0,22%	-0,36%	-0,02%	-0,23%	0,08%	-0,07%	-0,30%	0,02%	-0,33%	0,10%	-0,07%	-0,14%	**-1,11%**
	Friday	-0,58%	-0,04%	0,22%	0,26%	0,22%	-0,18%	0,00%	-0,50%	0,00%	0,00%	-0,16%	0,00%	-0,76%
2003	Monday	-0,08%	-0,06%	-0,05%	0,08%	-0,14%	0,08%	-0,04%	0,05%	0,00%	0,12%	0,13%	0,47%	**0,57%**
	Friday	-0,30%	0,25%	-0,19%	-0,02%	0,09%	0,00%	0,11%	0,09%	-0,25%	0,47%	0,00%	0,02%	0,27%
2004	Monday	0,25%	0,00%	0,00%	0,02%	0,00%	0,04%	-0,11%	0,08%	-0,10%	-0,05%	-0,03%	0,13%	**0,23%**
	Friday	0,12%	0,05%	-0,04%	0,40%	0,15%	0,00%	0,00%	0,00%	-0,19%	-0,07%	0,12%	-0,23%	0,29%
2005	Monday	0,19%	0,00%	0,03%	0,09%	-0,02%	-0,05%	-0,11%	-0,13%	0,02%	0,01%	-0,02%	0,00%	**0,01%**
	Friday	0,00%	0,02%	0,00%	-0,11%	-0,01%	-0,02%	0,02%	-0,18%	-0,01%	0,04%	0,56%	0,02%	0,33%
2006	Monday	0,04%	-0,13%	0,00%	0,63%	-0,05%	-0,05%	0,03%	-0,01%	-0,01%	-0,01%	-0,06%	-0,01%	**0,37%**
	Friday	0,09%	-0,17%	0,03%	0,00%	-0,07%	0,01%	-0,01%	0,43%	-0,05%	0,01%	0,04%	-0,05%	0,27%
2007	Monday	-0,04%	-0,03%	0,04%	0,05%	-0,01%	-0,02%	0,08%	0,12%	0,00%	-0,23%	-0,27%	-0,48%	**-0,80%**
	Friday	0,00%	0,02%	0,11%	-0,01%	0,07%	0,00%	-0,02%	-0,22%	-0,11%	0,58%	0,50%	0,14%	-0,01%
2008	Monday	0,00%	-0,03%	-0,29%	-0,01%	-0,09%	0,05%	0,26%	-0,17%	0,28%	1,24%	-0,57%	0,19%	**0,85%**
	Friday	0,41%	-0,02%	-0,22%	-0,01%	-0,15%	0,00%	-0,10%	-0,08%	-0,40%	-2,80%	-0,55%	-3,09%	-7,01%
2009	Monday	-0,30%	-0,38%	0,42%	-2,94%	-1,10%	-0,39%	-0,01%	-0,14%	-0,27%	0,08%	0,62%	0,11%	**-4,29%**
	Friday	-2,12%	-3,70%	0,48%	1,59%	1,83%	-0,45%	-0,31%	0,27%	-0,15%	-0,07%	-0,17%	0,31%	-2,50%
2010	Monday	0,08%	0,01%	-0,06%	0,05%	1,10%	0,63%	0,02%	0,08%	0,05%	0,03%	0,27%	0,08%	**2,33%**
	Friday	-0,26%	-0,25%	0,32%	-0,19%	-0,16%	-0,64%	-0,39%	0,18%	0,19%	0,25%	-0,43%	-0,15%	-1,54%
2011	Monday	-0,05%	0,05%	-0,24%	-0,51%	-0,01%	0,03%	-0,03%	-0,07%	-0,15%	0,27%	-0,02%	0,00%	**-0,71%**
	Friday	-0,03%	-0,04%	0,13%	0,00%	-0,03%	0,04%	-0,04%	0,00%	-0,19%	0,15%	-0,01%	0,12%	0,10%
2012	Monday	-0,01%	-0,01%	-0,01%	-0,01%	0,03%	-0,02%	-0,03%	0,00%	-0,06%	0,00%	0,00%	-0,01%	**-0,12%**
	Friday	-0,10%	-0,01%	0,00%	0,00%	0,00%	-0,11%	-0,04%	0,00%	0,00%	0,00%	0,00%	-0,01%	-0,06%
2013	Monday	0,00%	0,00%	0,00%	0,00%	-0,20%	0,15%	0,38%	-0,26%	0,15%	-0,37%	0,19%	0,48%	**0,50%**
	Friday	0,00%	0,00%	0,01%	0,00%	-0,25%	0,01%	-0,15%	0,09%	0,06%	0,35%	0,35%	0,42%	0,89%
2014	Monday	0,03%	-0,01%	0,13%	0,21%	-0,07%	-0,08%	-0,01%	0,51%	-0,26%	-0,06%	0,01%	-0,10%	**0,29%**
	Friday	-0,18%	0,19%	0,20%	-0,10%	0,14%	0,15%	0,06%	0,28%	0,06%	0,45%	0,40%	-0,10%	1,55%
2015	Monday	-0,19%	-0,04%	0,32%	0,11%	0,00%	-0,11%	-0,03%	-0,29%	0,13%	0,12%	-0,05%	0,07%	**0,04%**
	Friday	-0,06%	0,02%	-0,04%	-0,10%	0,31%	-0,10%	0,33%	-0,22%	-0,05%	0,24%	-0,05%	-0,22%	0,05%
2016	Monday	-0,10%	-0,23%	-0,33%	-0,05%	0,10%	-0,21%	0,04%	0,06%	-0,38%	0,63%	0,86%	0,42%	**0,81%**
	Friday	0,36%	0,22%	0,32%	-0,15%	-0,13%	-0,78%	0,52%	0,11%	-0,22%	0,37%	0,40%	0,44%	0,67%
2017	Monday	-0,68%	0,02%	-1,01%	1,13%	0,57%	0,30%	0,45%	0,75%	0,51%	0,23%	-0,20%	0,97%	**3,02%**
	Friday	0,57%	0,01%	0,43%	0,12%	0,25%	0,51%	-0,29%	0,45%	-0,14%	0,60%	-0,07%	0,63%	3,07%
2018	Monday	-0,25%	0,26%	0,58%	1,12%	0,91%	-0,63%	-0,26%	0,56%	0,03%	1,15%	0,33%	0,53%	**4,30%**
	Friday	0,82%	0,63%	0,04%	0,14%	-0,58%	0,96%	0,17%	-0,39%	-0,20%	0,43%	-1,32%	-0,64%	0,06%
2019	Monday	-1,21%	0,58%	0,38%	0,19%	-3,29%	0,54%	0,92%	-0,01%	-0,15%	0,25%	0,13%	0,58%	**-1,08%**
	Friday	1,90%	0,17%	0,01%	0,59%	-0,93%	0,39%	0,35%	0,04%	0,55%	0,85%	0,72%	1,28%	5,91%
2020	Monday	-1,82%	-2,37%	-10,37%	2,96%	0,71%	-1,35%	1,55%	1,57%	0,73%				**-8,38%**
	Friday	-0,36%	-2,64%	-0,59%	1,59%	-1,49%	4,41%	0,50%	-0,11%	0,07%				1,39%
SUM	**Monday**	**-3,74%**	**-2,23%**	**-9,17%**	**1,36%**	**-1,03%**	**-0,78%**	**2,54%**	**2,95%**	**0,64%**	**2,93%**	**1,06%**	**3,66%**	**-1,82%**
	Friday	**0,71%**	**-6,54%**	**2,43%**	**3,93%**	**-1,71%**	**5,46%**	**1,26%**	**0,23%**	**-2,06%**	**0,82%**	**-1,25%**	**1,19%**	**4,47%**

Table 6 - Summed variations from close to open prices

Regarding Table 7, a concentration around null changes is clear for every month. The tendency of prices to change upwards versus downwards does not appear to differ significantly for Mondays in sum.

Direction Analysis:														
	Direction	January	February	March	April	May	June	July	August	September	October	November	December	SUM
Mondays	UP	26	27	41	42	33	43	41	52	34	38	45	49	471
	NULL	65	55	83	78	64	78	72	66	52	76	73	66	828
	DOWN	43	34	43	44	32	42	46	50	40	54	44	43	515
	SUM	134	116	167	164	129	163	159	168	126	168	162	158	1814
Fridays	UP	50	31	44	33	38	37	47	43	34	44	43	51	495
	NULL	73	73	81	67	79	81	74	75	79	89	76	70	917
	DOWN	40	49	34	34	52	44	36	51	50	34	45	37	506
	SUM	163	153	159	134	169	162	157	169	163	167	164	158	1918
	Direction	January	February	March	April	May	June	July	August	September	October	November	December	SUM
Mondays	UP	19%	23%	25%	26%	26%	26%	26%	31%	27%	23%	28%	31%	26%
	NULL	49%	47%	50%	48%	50%	48%	45%	39%	41%	45%	45%	42%	46%
	DOWN	32%	29%	26%	27%	25%	26%	29%	30%	32%	32%	27%	27%	28%
	SUM	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Fridays	UP	31%	20%	28%	25%	22%	23%	30%	25%	21%	26%	26%	32%	26%
	NULL	45%	48%	51%	50%	47%	50%	47%	44%	48%	53%	46%	44%	48%
	DOWN	25%	32%	21%	25%	31%	27%	23%	30%	31%	20%	27%	23%	26%
	SUM	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Holidays Count		January	February	March	April	May	June	July	August	September	October	November	December	SUM
Mondays		34	38	0	0	38	0	10	0	38	1	0	11	170
Fridays		5	0	10	28	0	1	11	0	1	0	0	10	66

Table 7 - Direction analysis from close to open price change

Tests of significance to the difference in the means between Monday and the other weekdays were done, but all revealed equality between means. They can be seen in the Appendix section.

Analyzing Monday's behavior depending on Friday's movement is not as interesting for this case since most cases would result in null changes.

Pairwise correlation coefficients between the price change from Thursday to Friday close and Friday close to Monday open shows a high significance level. Interestingly, the two variables have a negative relation of -10,05%.

4.2. Holiday Effect

Figure 3 depicts the distribution of price change from close to close, for the days that precede holidays and for those that do not.

The whisker's maximum and minimum values are roughly equal between each of the groups, and the medians of both groups are zero. The box plot depicting pre-holiday days does not reveal any "extreme" outlier. In fact, it shows there is no registry of a price change of more than 5% during this period for this group.

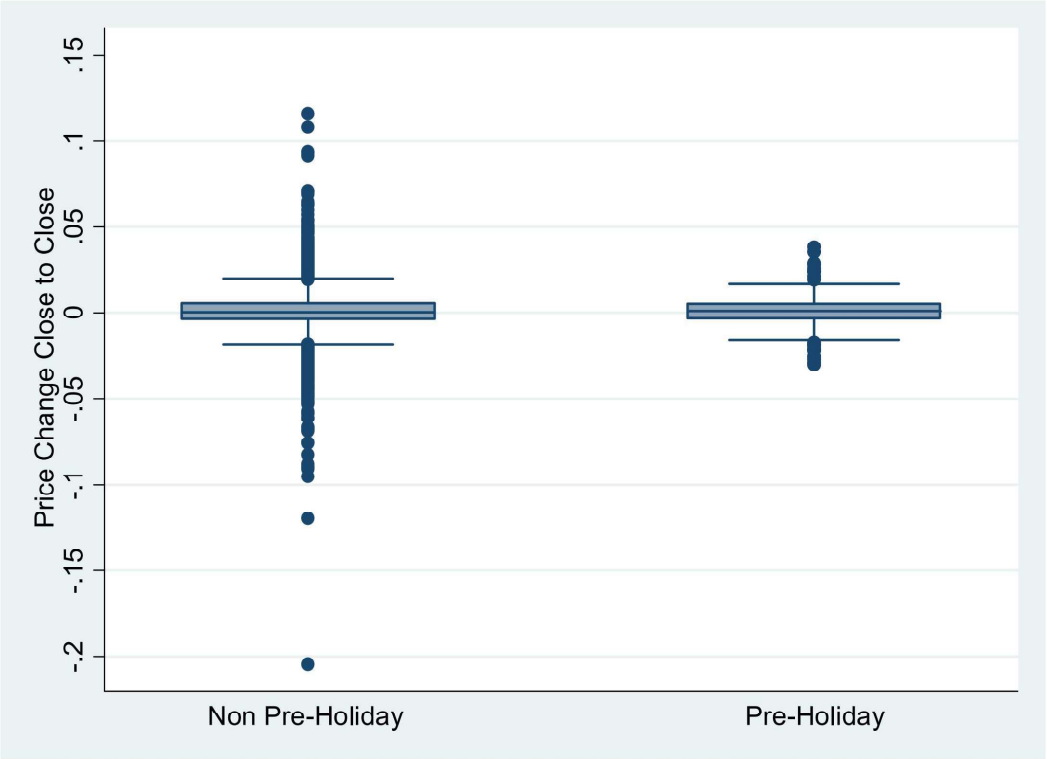

Figure 3 - Box plot depicting price change for non-pre-holiday days and pre-holiday days

The days that precede holidays account for roughly 3,25% of all observations. The total change in prices from pre-holiday days for the period was approximately 33,59%. Since the index's total growth for the period being analyzed was 394,40%, daily growth uniformity would result in a total contribution of 12,82% (394,40%×3,25%) from this group.

In table 8, it is possible to see the statistics regarding price change for each holiday. The bottom line represents all holidays in aggregate, therefore, some variables (AVG, %UP, %DOWN) are not a literal summation of the lines above but a representation of all days preceding every holiday considered.

the bottom right part of Table 8, it is possible to see an upward tendency in price change direction for the days preceding a holiday during this period, with 58% of the time, the price registering a positive change.

Holidays	SUM	Obs	AVG	Up Days	Down Days	%UP	%DOWN
New Year's Day	-4.88%	33	-0.15%	14	19	42%	58%
Martin Luther King, Jr. Day	4.63%	23	0.20%	15	8	65%	35%
Washington's Birthday	-2.36%	38	-0.06%	18	20	47%	53%
Good Friday	15.83%	38	0.42%	25	13	66%	34%
Memorial Day	-0.07%	38	0.00%	21	17	55%	45%
Independence Day	3.86%	38	0.10%	23	15	61%	39%
Labor Day	3.20%	38	0.08%	22	16	58%	42%
Thanksgiving Day	8.96%	38	0.24%	27	11	71%	29%
Christmas Day	4.40%	38	0.12%	21	17	55%	45%
SUM	**33.59%**	322	**0.10%**	186	136	**58%**	**42%**

Table 8 - Descriptive statistics of pre-holiday days across the period

The holiday that has presented the biggest summed price change during this period was the Good Friday holiday, with a total change of 15,83%. It is possible to see that this holiday has shown an upward price change tendency 66% of the time. The Thanksgiving Day holiday was the second holiday with the biggest summed change, with a total variation of 8,96%. This was accompanied by an upwards price change tendency of 71% of the time. The two worst contributors to the price growth were New Year's Day and Washington's Birthday holiday, which are also the only two holidays with a bigger tendency for downward price change. Their price has presented negative changes 58% and 53% of the time, respectively.

The following table (Table 9) shows a t-test to the difference in the means between pre-holiday days and non-pre-holiday days price change.

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Non-pre-holiday	9267	0,0003902	0,0001195	0,0115083	0,0001558	0,0006245
Pre-holiday	322	0,0010431	0,0004981	0,0089382	0,0000631	0,002023
Combined	9589	0,0004121	0,0001167	0,0114316	0,0001833	0,0006409
diff		-0,0006529	0,000648		-0,0019232	0,0006174
diff = mean (**0**) - mean (**1**)					t =	-1,0075
H0: diff = 0					degrees of freedom =	9587
Ha: diff < 0			Ha: diff ≠ 0		Ha: diff > 0	
Pr (T < t) = **0.1569**			Pr (|T| > |t|) = **0.3137**		Pr (T > t) = **0.8431**	

Table 9 - T-test for the difference in the means between non-pre-holiday days and pre-holiday days

With a mean of 0,039% for returns in days that do not precede holidays and 0,104% for the group of days that precede holidays, the t-test reveals that the difference between means is not statistically significant.

The previous analysis of each holiday helps to understand that returns vary highly between holidays. By testing each holiday individually, it is possible to see a negative difference in the means between the price change occurring on the day before the Good Friday holiday and the rest of the year, statistically significant at the 5% level. This finding supports the hypothesis of an above average return for the day preceding the Good Friday holiday.

Tests done for other holidays did not find any statistically significant difference in

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Non-pre-holiday	9551	0.0003972	0.0001170	0.0114371	0.0001677	0.0006266
Pre-holiday	38	0.0041658	0.0015134	0.0093291	0.0010994	0.0072322
Combined	9589	0.0004121	0.0001167	0.0114316	0.0001832	0.0006409
diff		-0.0037687	0.0018578		-0.0074104	-0.0001269
diff = mean (**0**) - mean (**1**)					t =	-2.0285
H0: diff = 0					degrees of freedom =	9587
Ha: diff < 0			Ha: diff ≠ 0		Ha: diff > 0	
Pr (T < t) = **0.0213**			Pr (|T| > |t|) = **0.0425**		Pr (T > t) = **0.9787**	

Table 10 - T-test for the difference in the means between the day preceding the Good Friday holiday and the rest of the days

the means. The following table consists of a summary of the results from these tests.

Holidays	Ha: diff < 0 Pr (T < t)	Ha: diff ≠ 0 Pr (|T| > |t|)	Ha: diff > 0 Pr (T > t)
New Year's day	0.8295	0.3411	0.1705
Martin Luther King, Jr. Day	0.2504	0.5009	0.7496
Washington's Birthday	0.7114	0.5771	0.2886
Goood Friday	0.0213	0.0425	0.9787
Memorial Day	0.5917	0.8166	0.4083
Independence Day	0.3722	0.7443	0.6278
Labor Day	0.4083	0.8165	0.5917
Thanksgiving Day	0.1465	0.2929	0.8535
Christmas Day	0.3433	0.6866	0.6567

Table 11 - Summary of results from t-tests to the difference in returns of each holiday

It is possible to see the t-tests done on each holiday individually in the appendix with more detail from Table A9 to Table A16.

5. Conclusions

During the 38-year period studied, a Monday effect was found from 1982 until 1988, when considering close to close price changes. The average return of this weekday, for this period, was negative and statistically significant below average when compared to the other weekdays. These observations support the generality of findings

from the different studies mentioned in section 2.1. regarding the existence of a Monday effect until the effect was identified as being vanished. After 1988 there is no indication that this effect persists to exist in the S&P500.

Arbitrage theory argues that anomalies cease to exist once noticed, suggesting a possible reason for the disappearance of this effect being investors exploiting this anomaly until it stopped being profitable.

A Friday effect, where above average returns are expected, was never found for the entire period analyzed. These findings reveal no similarities with the studies of Anwar and Mulyadi (2012) and Kumar (2018).

This study did not find similarities to French (1980) and Rogalski (1984) when looking at data from the non-trading weekend (change from Friday close to Monday open). No significant movements were found over the weekend for the entire period, even when considering only the period where a Monday effect was found. Additionally, no statistically significant difference in return behavior across months was found for the entire period.

Considering the S&P500 Index since January 1989, having found no anomaly in the price changes over the week and weekends, the findings support the conclusion that, at the current moment, calendar time is inconsistent, but trading time is consistent with reality. Therefore, the evidence supports that returns are being generated during active trading, which no longer corresponds to the observance made in French (1980).

A positive correlation between Friday price change and Monday price change was only found when looking at price change from close to close. However, the impact of a negative price change from Friday on the following Monday was less constant than the results found by Ariel (1994).

Regarding the holiday effect, the mean change for these days was 2,78 times higher than the rest of the days. This result is considerably inferior to the observances from Ariel (1985) and Lakonishok and Smidt (1988), where magnitudes of approximately 10 times and 23 times greater returns, respectively, during pre-holiday days were reported.

No statistically significant above-average returns are found for the group of pre-holiday days during the period analyzed, revealing no similarities to the studies mentioned in section 2.3.

When looking at each holiday individually, the day preceding the Good Friday holiday presented a mean change 10,5 times higher than the average daily rate of return, being the only day preceding a holiday to show statistically significant above-average returns.

The ANOVA test to the difference in the means between months in the appendix (Table A6) did not find any statistically significant difference. However, the pattern of returns across months does seem to reveal some evidence supporting the Halloween indicator (also known as "Sell in May and go away"), supporting the conclusion of Zhang and Jacobsen (2021). When looking at the months from May until October, every monthly mean return is inferior to the rest of the months (November – April), except for February.

Since the index analyzed is the S&P500, future studies can replicate this work for indexes in specific sectors, indexes of small and medium-capitalization companies, or indexes from different countries.

Additionally, an in-depth analysis of the inconsistency found in the correlation between Friday close to Monday open and Friday close to Monday close price change might reveal an interesting pattern. If the intent is to find a profitable trading strategy, range data of daily prices might be useful when defining risk management.

This study fails in understanding why the holiday effect exists only for the Good Friday holiday. Another limitation of this work comes from the analysis being restricted to large-cap companies from the United States. If the findings from this work are transversal to other countries or immune to companies' size, only future studies can verify.

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Appendices

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Not Monday	7775	0.0004813	0.0001241	0.0109448	0.000238	0.0007246
Monday	1814	0.0001155	0.0003127	0.0133175	-0.0004977	0.0007288
Combined	9589	0.0004121	0.0001167	0.0114316	0.0001832	0.0006409
diff		0.0003658	0.0002981		-0.0002185	0.00095
diff = mean (**0**) - mean (**1**)					t =	1.2271
H0: diff = 0					degrees of freedom =	9587
Ha: diff < 0		Ha: diff ≠ 0			Ha: diff > 0	
Pr (T < t) = **0.8901**		Pr (|T| > |t|) = **0.2198**			Pr (T > t) = **0.1099**	

Table A1 – T-test for the difference in the means between Monday's and the other weekdays close to close returns

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Not Monday	1286	0.000974	0.0002845	0.0102012	0.0004159	0.001532
Monday	304	-0.0010648	0.0009249	0.0161268	-0.0028849	0.0007553
Combined	1590	0.0005842	0.0002907	0.0115927	0.0000139	0.0011544
diff		0.0020388	0.0007378		0.0005917	0.0034859
diff = mean (**0**) - mean (**1**)					t =	2.7634
H0: diff = 0					degrees of freedom =	1588
Ha: diff < 0		Ha: diff ≠ 0			Ha: diff > 0	
Pr (T < t) = **0.9971**		Pr (|T| > |t|) = **0.0058**			Pr (T > t) = **0.0029**	

Table A2 - T-test for the difference in the means between Monday's and the other weekdays close to close returns for the period from September 1982 to December 1988

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Not Monday	6489	0.0003836	0.0001376	0.0110844	0.0001139	0.0006534
Monday	1510	0.0003532	0.0003261	0.0126699	-0.0002864	0.0009927
Combined	7999	0.0003779	0.0001275	0.0113997	0.000128	0.0006277
diff		0.0000305	0.0003257		-0.000608	0.000669
diff = mean (**0**) - mean (**1**)					t =	0.0936
H0: diff = 0					degrees of freedom =	7997
Ha: diff < 0		Ha: diff ≠ 0			Ha: diff > 0	
Pr (T < t) = **0.5373**		Pr (|T| > |t|) = **0.9255**			Pr (T > t) = **0.4627**	

Table A3 - T-test for the difference in the means between Monday's and the other weekdays close to close returns for the period from January 1989 to September 2020

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Not Friday	1273	0.0005552	0.0003368	0.0120183	-0.0001056	0.001216
Friday	317	0.0007006	0.0005456	0.0097133	-0.0003728	0.001774
Combined	1590	0.0005842	0.0002907	0.0115927	0.0000139	0.0011544
diff		-0.0001454	0.0007279		-0.0015731	0.0012824
diff = mean (**0**) - mean (**1**)					t =	-0.1997
H0: diff = 0					degrees of freedom =	1588
Ha: diff < 0		Ha: diff ≠ 0			Ha: diff > 0	
Pr (T < t) = **0.4209**		Pr (|T| > |t|) = **0.8417**			Pr (T > t) = **0.5791**	

Table A4 - T-test for the difference in the means between Friday's and the other weekdays close to close returns for the period from September 1982 to December 1988

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Not Friday	6398	0.0004235	0.0001449	0.0115899	0.0001394	0.0007075
Friday	1601	0.0001957	0.0002651	0.0106072	-0.0003242	0.0007157
Combined	7999	0.0003779	0.0001275	0.0113997	0.000128	0.0006277
diff		0.0002277	0.0003186		-0.0003968	0.0008522
diff = mean (**0**) - mean (**1**)					t =	0.7148
H0: diff = 0					degrees of freedom =	7997
Ha: diff < 0		Ha: diff ≠ 0			Ha: diff > 0	
Pr (T < t) = **0.7626**		Pr (|T| > |t|) = **0.4747**			Pr (T > t) = **0.2374**	

Table A5 - T-test for the difference in the means between Friday's and the other weekdays close to close returns for the period from January 1989 to September 2020

Weekday	Summary of Price Change Close to Close		
	Mean	Std. Dev.	Freq.
January	0.00057124	0.01079956	786
Februrary	0.00017848	0.01000374	729
March	0.00051385	0.01403785	830
April	0.00093282	0.01073476	785
May	0.00047199	0.00938636	805
June	0.00016972	0.00935345	812
July	0.00046332	0.00946354	804
August	0.00001891	0.01087598	841
September	-0.00029972	0.01155022	779
October	0.00050939	0.0164969	840
November	0.00069237	0.01172239	777
December	0.00071793	0.01012629	801
Total	0.00041208	0.0114316	9589

Analysis of Variance					
Source	SS	df	MS	F	Prob > F
Between Groups	0.00100247	11	0.000091133	0.70	**0.7426**
Within Groups	1.25197145	9577	0.000130727		
Total	1.25297391	9588	0.000130681		
Bartlett's test for equal variances: chi2(11) = 597.7332 Prob>chi2 = 0.000					

Table A6 - One-way ANOVA test to the difference in the means of close to close returns between months

Weekday	Summary of Price Change Close to Open		
	Mean	Std. Dev.	Freq.
Monday	-0.00001	0.00304012	1814
Tuesday	0.0001533	0.00239946	1965
Wednesday	-0.00002151	0.00242241	1963
Thursday	-0.00001499	0.00223798	1929
Friday	0.00002313	0.00257018	1918
Total	0.00002673	0.00254166	9589

Analysis of Variance					
Source	SS	df	MS	F	Prob > F
Between Groups	0.000041876	4	0.000010469	1.62	0.1659
Within Groups	0.061896946	9584	0.000006458		
Total	0.061938822	9588	0.00000646		
Bartlett's test for equal variances: chi2(4) = 210.7097 Prob>chi2 = 0.000					

Table A7 - One-way ANOVA test to the difference in the means of close to open returns between weekdays

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Not Friday	7775	0.0000353	0.0000273	0.0024107	-0.0000183	0.0000889
Friday	1814	-0.00001	0.0000714	0.0030401	-0.00015	0.00013
Combined	9589	0.0000267	0.000026	0.0025417	-0.0000241	0.0000776
diff		0.0000453	0.0000663		-0.0000846	0.0001752
diff = mean (**0**) - mean (**1**)					t =	0.6833
H0: diff = 0					degrees of freedom =	9587
Ha: diff < 0		Ha: diff ≠ 0			Ha: diff > 0	
Pr (T < t) = **0.7528**		Pr (|T| > |t|) = **0.4944**			Pr (T > t) = **0.2472**	

Table A8 - T-test for the difference in the means between Friday's and the other weekdays close to open returns

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Not Pre-NYD-Holiday	9556	0.0004186	0.0001171	0.0114425	0.0001892	0.0006481
Pre-NYD-Holiday	33	-0.0014792	0.0013069	0.0075075	-0.0041413	0.0011828
Combined	9589	0.0004121	0.0001167	0.0114316	0.0001832	0.0006409
diff		0.0018978	0.0019934		-0.0020097	0.0058054
diff = mean (**0**) - mean (**1**)					t =	0.9529
H0: diff = 0					degrees of freedom =	9587
Ha: diff < 0		Ha: diff ≠ 0			Ha: diff > 0	
Pr (T < t) = **0.8295**		Pr (|T| > |t|) = **0.3411**			Pr (T > t) = **0.1705**	

Table A9 - T-test for the difference in the means between the day preceding the New Year's Day holiday and the rest of the days

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Not Pre-MLK-Holiday	9566	0.0004082	0.0001169	0.0114339	0.0001791	0.0006374
Pre-MLK-Holiday	23	0.0020147	0.002201	0.0105558	-0.0025499	0.0065794
Combined	9589	0.0004121	0.0001167	0.0114316	0.0001832	0.0006409
diff		-0.0016065	0.0023866		-0.0062847	0.0030717
diff = mean (**0**) - mean (**1**)					t =	-0.6731
H0: diff = 0					degrees of freedom =	9587
Ha: diff < 0		Ha: diff ≠ 0			Ha: diff > 0	
Pr (T < t) = **0.2504**		Pr (|T| > |t|) = **0.5009**			Pr (T > t) = **0.7496**	

Table A10 - T-test for the difference in the means between the day preceding the Martin Luther King, Jr. Day holiday and the rest of the days

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Not Pre-WB-Holiday	9551	0.0004162	0.000117	0.0114368	0.0001868	0.0006456
Pre-WB-Holiday	38	-0.00062	0.00164	0.0101099	-0.003943	0.0027031
Combined	9589	0.0004121	0.0001167	0.0114316	0.0001832	0.0006409
diff		0.0010362	0.0018582		-0.0026063	0.0046786
diff = mean (**0**) - mean (**1**)					t =	0.5576
H0: diff = 0					degrees of freedom =	9587
Ha: diff < 0		Ha: diff ≠ 0			Ha: diff > 0	
Pr (T < t) = **0.7114**		Pr (|T| > |t|) = **0.5771**			Pr (T > t) = **0.2886**	

Table A11 - T-test for the difference in the means between the day preceding the Washington Birthday holiday and the rest of the days

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Not Pre-MEM-Holiday	9551	0.0004138	0.0001171	0.0114464	0.0001842	0.0006434
Pre-MEM-Holiday	38	-0.0000172	0.0011089	0.0068356	-0.002264	0.0022296
Combined	9589	0.0004121	0.0001167	0.0114316	0.0001832	0.0006409
diff		0.000431	0.0018582		-0.0032115	0.0040735
diff = mean (**0**) - mean (**1**)					t =	0.2319
H0: diff = 0					degrees of freedom =	9587
Ha: diff < 0			Ha: diff ≠ 0		Ha: diff > 0	
Pr (T < t) = **0.5917**			Pr (|T| > |t|) = **0.8166**		Pr (T > t) = **0.4083**	

Table A12 - T-test for the difference in the means between the day preceding the Memorial Day holiday and the rest of the days

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Not Pre-IND-Holiday	9551	0.0004097	0.0001171	0.0114442	0.0001801	0.0006392
Pre-IND-Holiday	38	0.0010158	0.0012509	0.0077108	-0.0015187	0.0035503
Combined	9589	0.0004121	0.0001167	0.0114316	0.0001832	0.0006409
diff		-0.0006061	0.0018582		-0.0042486	0.0030364
diff = mean (**0**) - mean (**1**)					t =	-0.3262
H0: diff = 0					degrees of freedom =	9587
Ha: diff < 0			Ha: diff ≠ 0		Ha: diff > 0	
Pr (T < t) = **0.3722**			Pr (|T| > |t|) = **0.7443**		Pr (T > t) = **0.6278**	

Table A13 - T-test for the difference in the means between the day preceding the Independence Day holiday and the rest of the days

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Not Pre-LAB-Holiday	9551	0.0004104	0.000117	0.0114374	0.000181	0.0006398
Pre-LAB-Holiday	38	0.0008415	0.0016197	0.0099846	-0.0024403	0.0041234
Combined	9589	0.0004121	0.0001167	0.0114316	0.0001832	0.0006409
diff		-0.0004312	0.0018582		-0.0040737	0.0032114
diff = mean (**0**) - mean (**1**)					t =	-0.2320
H0: diff = 0					degrees of freedom =	9587
Ha: diff < 0			Ha: diff ≠ 0		Ha: diff > 0	
Pr (T < t) = **0.4083**			Pr (|T| > |t|) = **0.8165**		Pr (T > t) = **0.5917**	

Table A14 - T-test for the difference in the means between the day preceding the Labor Day holiday and the rest of the days

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Not Pre-TG-Holiday	9551	0.0004043	0.000117	0.0114365	0.000175	0.0006337
Pre-TG-Holiday	38	0.0023587	0.0016315	0.0100572	-0.000947	0.0056644
Combined	9589	0.0004121	0.0001167	0.0114316	0.0001832	0.0006409
diff		-0.0019544	0.0018581		-0.0055967	0.0016879
diff = mean (**0**) - mean (**1**)					t =	-1.0518
H0: diff = 0					degrees of freedom =	9587
Ha: diff < 0			Ha: diff ≠ 0		Ha: diff > 0	
Pr (T < t) = **0.1465**			Pr (|T| > |t|) = **0.2929**		Pr (T > t) = **0.8535**	

Table A15 - T-test for the difference in the means between the day preceding the Thanksgiving Day holiday and the rest of the days

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]	
Not Pre-CHRS-Holiday	9551	0.0004091	0.0001171	0.0114441	0.0001796	0.0006387
Pre-CHRS-Holiday	38	0.0011589	0.0012539	0.0077294	-0.0013817	0.0036995
Combined	9589	0.0004121	0.0001167	0.0114316	0.0001832	0.0006409
diff		-0.0007498	0.0018582		-0.0043923	0.0028927
diff = mean (**0**) - mean (**1**)					t =	-0.4035
H0: diff = 0					degrees of freedom =	9587
Ha: diff < 0		Ha: diff ≠ 0			Ha: diff > 0	
Pr (T < t) = **0.3433**		Pr (|T| > |t|) = **0.6866**			Pr (T > t) = **0.6567**	

Table A16 - T-test for the difference in the means between the day preceding the Christmas Day holiday and the rest of the days