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Calendar Anomalies on the US Stock Markets

Name student: Max Witte
Student ID number: 482604

Supervisor: Omar Commandeur

Second assessor: Jam Lemmen

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Abstract

From 1970 on, different calendar anomalies on stock markets around the globe have been researched. The existing idea of the Efficient Market Hypothesis was violated by these anomalies. Later research from 1995 onwards shows a evaporation of the anomalies. The question remains if these anomalies have made a re-entrance on the US stock markets. The January effect, the Turn-of-the-month effect, the End-of-December effect and the Weekend effect are inquired among five indexes on the US stock market. Return data for the Total US Market, Mega US Market, Large US Market, Mid US Market and Small US Market is analysed over the period 2014 – 2019. Only for the Weekend effect statistical evidence is found for the Mid US Market. For all other anomalies on all other indexes, no prove of their existence was found which is in line with the most recent research.

Introduction

Already in 1976, a paper on the January effect was written by Rozeff and Kinney in which was concluded that there were significantly higher returns in the month of January than in all other months on the New York Stock Exchange. In the following decennia more and more evidence was found, not only for the New York Stock Exchange and not only for the January effect, but for almost all stock exchanges around the world and for many different calendar anomalies (Hawawini and Keim, 1995, Gultekin and Gultekin, 1983 and Ziembe and Hensel, 1994). This violates the existing ideas around the capital asset pricing models and the Efficient Market Hypothesis, in which only deviations in risk contribute to deviations in return (van der Sar, 2018). As for some of these calendar anomalies, strong evidence of their existence has disappeared. For others, it has been concluded that they have vanished altogether (Marquering, Nisser and Valla, 2006). This partial fading to total dissipation of certain calendar anomalies on the stock markets makes one wonder if these anomalies will stay away forever or if they have made a re-entrance on current stock markets.

In this paper, research will be conducted on calendar anomalies on the US stock markets. Calendar anomalies are systematic deviations of returns in the form of patterns in time series which are not explained by changes in risk. These systematic deviations of returns can have several causes: problems with the data used for research, the change or risk, laws and regulations and by strategic decisions and strategies of investors (van der Sar, 2003). However, these factors on a standalone basis do not explain the deviations fully.

Research will be conducted over the US Total Market Index, as well as over the separate market indexes: US Mega Market Index, US Large Market Index, US Mid Market Index and the US Small Market Index. In total, four different calendar anomalies are discussed in this paper. Firstly, the January effect which is the significant higher return in month of January. Furthermore, the Turn-of-the-month effect will be discussed which is the significantly higher return during the last day of the previous month and the first three days in the next month. Thirdly, the End-of-December effect which embodies the significantly higher returns during the second half of December relative to the first half of the month December. Lastly, the Weekend effect which entails the significantly lower returns on Mondays than on all other days of the week. These four calendar anomalies are tested over the different indexes which results in the following hypotheses to be formulated:

A January effect is observable on the different indexes in the period 2014 – 2019

A Turn-of-the-month effect is observable on the different indexes in the period 2014 – 2019

A End-of-December effect is observable on the different indexes in the period 2014 – 2019

A Weekend effect is observable on the different indexes in the period 2014 - 2019

First of all, the theoretical framework with the hypotheses is presented. After this, a literature review will be conducted among the four different calendar anomalies. Then, the data and applied statistical methods will be discussed. Next, in the results, the data found will be presented. Lastly, the conclusion will be presented.

Theoretical framework

Calendar anomalies

Calendar anomalies are systematic deviations from the Efficient Market Hypothesis of stock returns which can not be explained by the existing asset pricing models. These systematic deviations can thus be caused by inefficiencies in the stock market or by inefficiencies in the asset pricing models. Several different calendar anomalies have been investigated over the years under which the calendar anomalies that will be investigated in this paper.

Efficient Market Hypothesis

The fundamental theorem underlying the explanation for all price changes observable on different products on the stock markets caused by events is the Efficient Market Hypothesis. The Efficient Market Hypothesis states that prices being realized contain all available information of relevance at all times (Fama, 1970). There are three different forms of the Efficient Market Hypothesis: the strong form, the semi-strong form and the weak form.

The strong form of the Efficient Market Hypothesis states that all information, private as well as public, will be incorporated into the price of a stock immediately. Private information is all information that is only known to a relative small amount of people because of their position within certain companies; this is also known as insider information. The strong form of the Efficient Market Hypothesis makes it inherently impossible for investors to make structural positive returns on the stock market.

The semi-strong form of the Efficient Market Hypothesis is a much more relaxed form of the strong form of the Efficient Market Hypothesis. It states that not all information, but only public information is immediately incorporated into the stock prices. This means that only investors with private information are able to make structural positive returns.

The weak form of the Efficient Market Hypothesis is the most relaxed form of the Efficient Market Hypothesis. In this form, only historical stock prices are seen as information that is incorporated into the prices of the stock. This means that private information and public information are not incorporated into the prices of the stock, hence investors can use private information and public information to gain structural positive returns.

Capital Asset Pricing Model (CAPM)

The Capital Asset Pricing Model, or CAPM, was first introduced by Shrape in 1964 and later by Lintner in 1965 and Mossin in 1966. It has been the standard model for measuring the expected returns for decades. It assumes that the systematic risk or so-called beta risk is the only explanatory measure for

systematically higher or lower returns relative to the risk-free market return. The expected return of the portfolio is computed as follows:

$$E(R_i - R_f) = R_f + \beta_i * (E(R_m) - R_f)$$

Where $E(R_i - R_f)$ equals the expected return of the portfolio. R_f is the risk-free rate of return on the market. The difference between the expected return of the market minus the return of the risk-free portfolio is also called the risk premium of the market. The risk premium of the market is multiplied with the beta or systemic risk of the portfolio. This results in the risk premium of the portfolio itself.

Literature review

January effect

As first presented by Rozeff and Kinney (1976) for the New York Stock Exchange, the January effect was present on indexes around the globe for years. Rozeff and Kinney presented evidence for the period 1904 – 1974 during which the returns in the month of January were significantly higher than in other months of the year. An important notation of Rozeff and Kinney was that the significantly higher return of the month January was mainly made in the first few days of that month.

There have been numerous hypotheses stated and tested to explain the existence of the January effect on stock markets, but none of them have been able to explain the January effect to its full extent. One of the first hypotheses made by Roll (1983) states that the January effect is caused by a systematic shift in the bid-ask spread due to selling pressure of the market, particularly at the end of the year and around the turn of the year.

Keim (1983) futher elaborates with his finding that more than 50% of the return in the month of January is made in the first week of the month. Later in 1989, Keim deepens on his explanation of this phenomena by adding that the selling pressure in the month of December causes closing prices to be for the most part bid quotes. Furthermore, in the month of January the closing prices are mainly at ask quotes. Important to note is that the bid-ask spread in the month of December and January may not change at all, however the shift from bid to ask quotes during these months causes the price to jump.

Furthermore, a size effect for the January effect was first discovered by Keim (1983). This size effect states that smaller companies are exposed to higher returns because of the January effect than larger firms. This size effect was further elaborated on by Rogalski and Tinic (1986) as well as Lakonishok and Smidt (1988). However, the idea of such a size effect was later opposed by Ritter and Chopra (1989) as small firms systematically outperformed the market in January.

Another possible explanation for the January effect is tax-loss selling, which was highlighted by Ferris, Haugen and Makhija (1988) and more recently by Poterba and Weisbenner (2001). The tax-loss selling hypothesis states that small individual investors try to gain from the tax deductibility of their realized losses by selling poor performing stocks at the end of the fiscal year. Another possible explanation is window dressing (Lakonishok, Shleifer, Thaler & Vishny, 1991 & Ritter, 1988) which applies to large institutional investors. They use this trick to hide poor performing stocks from their annual statements to be able to show an overall better performance to their clients.

More recent research (Cooper, McConnell & Ovtchinnikov, 2006, Mehdian & Perry, 2002 & Gu, 2003) shows a further evaporation of the January effect as no statistical significant evidence is found for the existence of the January effect. However, a so-called Other January effect is found, which states that if the returns in the month of January are positive, it is much more likely for the returns of the coming 11 months to be positive. On the other hand, if the returns in the month of January are negative, the returns in the coming 11 months are much more likely to be lower or negative as well.

Turn-of-the-month effect

As shown in many papers, the return for the January effect was mostly made in the first few days or the first week of January. Such a pattern was also discovered for each turn of the month by numerous papers. As Ariel (1987) found that stocks only achieved a positive return during the beginning and first half of the month and 0 return during the second half of the month for the US stock market. In a sense, the Turn-of-the-month effect is an extension of the January effect over the different months during the year.

More research for the US stock market was done by Hensel and Ziemba (1996) and by Lakonishok and Smidt (1988), which all came to the same conclusion as Ariel (1987) that the Turn-of-the-month effect was present on the US markets for a longer period of time. Later, research by Van der Sar and Dröge (2000) and Agrawal and Tandon (1994) showed evidence for countries around the globe.

In more recent years, the Turn-of-the-month effect was researched by McConnell and Xu (2008). They showed evidence for the existence of the Turn-of-the-month effect for 31 of the 35 countries examined. They also concluded that the driving factor for this effect is still a puzzle as buying pressure, which was accounted for by trading volume and by net cashflows to equity funds, doesn't have statistical significance in explaining the Turn-of-the-month effect.

Furthermore, emerging markets have been the topic for more research surrounding the Turn-of-the-month effect for the past four to five years. With the focus on Asian markets; Singh, Bhattacharjee and Kumar (2020) and Aziz and Ansari (2017) show that for these upcoming markets the Turn-of-the-month effect is present to a large extent.

End-of-December effect

The End-of-December effect was studied much later than the effects mentioned before. As first described in a paper by Lakonishok and Smidt (1988), the Dow Jones Industrial Average showed a significant higher return during the second half of December relative to the first half of the month December. Furthermore, a significant discrepancy is seen between the period from half of December up to Christmas and the period from Christmas to the end of the year.

Next to that, research on the Amsterdam stock exchange by Van der Sar (2003) has also shown significant higher returns for the period 1981 – 1998 during the pre-Christmas period and during the second half of December. On a more world-wide level, research by Van der Sar and Dröge (2000) concluded significantly higher returns for almost half of the 20 countries inquired during the period from Christmas to the end of the year.

Weekend effect

The weekend effect was first researched by Cross (1973) which concluded that on the Standard & Poor's Composite the returns on Mondays were significantly lower than on all other days of the week during the period 1953 – 1970. Later research on the Standard & Poor's 500 (Gibbons & Hess, 1981, Pettengill, 1989, French, 1980) concluded as well that on Mondays significantly lower returns were seen relative to all other days of the week.

The weekend effect has been researched for several decades and multiple hypotheses on the explanation of this effect have been tested. One of the first hypotheses was focused on the settlement of payments on the stock markets. As this research was done in a period with less technological development as oppose to now, a delay with the settlement period was inquired. Several studies (Dyl & Martin, 1985 , Lakonishok & Levi, 1982) concluded that this settlement period did not have a significant impact on the Monday returns and therefore couldn't explain the weekend effect.

A second hypothesis for the Weekend effect concerns the timing of announcements regarding dividends and earnings after closing time on Fridays. Research on this hypothesis conducted by Damodaran (1989) concluded that for all firms that make announcements on Fridays, a negative return on the following trading day is seen. For smaller firms this negative return is even larger.

Another hypothesis tested on several markets has more to do with the time spend by institutional investors relative to individual investors. The hypothesis states that institutional investors decrease their investment activity on Mondays and individual investors increase their investment activity as they only have time to invest themselves during the weekends. During weekdays, individual investors follow investment advice more which usually consists of more buy recommendations being followed. As sell decisions need greater individual effort, these will be done in the weekends and performed on the market on Mondays. Research on this hypothesis has been performed by Sias and Starks (1995), Chan, Leung and Wang (2005) and Lakonishok and Maberly (1990).

More recent research shows a large variety of different conclusions. For example, research by Van der Sar and Dröge (2000) concludes that the weekend effect has disappeared completely from the US stock markets. On the contrary, Boudreaux, Rao and Fuller (2010) conclude that the Weekend effect

is still present on the Dow Jones Industrial Average, Standard & Poor's 500 and the NASDAQ. A sidenote to this result is that the Weekend effect is only seen during non-bearish market orientations.

Data and methodology

Data description

In this paper, the US stock markets are researched as one. That is, all the different exchanges are congregated into different market indexes. This paper looks at the Total US Market index, Mega US Market index, Large US Market index, Mid US Market index and the Small US Market index. The data used in this paper is found in the database of the Center for Research in Security Prices (CRSP). Over the period of the 1st of January 2014 to the 31st of December 2019, the end of the day prices will be taken for the different market indexes that will be inquired. The data will be interpreted through an Ordinary Least Squares regression (OLS). In appendix 1 (figure 1.1 to 1.5), a graphical representation of the data can be found. In table 1.1 below, a global overview of the data is to be found:

Variable	Obs	Mean	Std. Dev.	Min	Max
US Total Market	1510	1758.349	277.257	1313.669	2381.285
US Mega Market	1510	1782.049	296.013	1309.495	2468.763
US Large Market	1510	1772.824	285.662	1309.623	2428.013
US Mid Market	1510	1729.951	237.592	1303.018	2237.22
US Small Market	1510	1674.761	232.635	1210.176	2115.741

Table 1.1: Summary of the statistics of the stock data of all markets inquired.

OLS assumptions

As OLS is used to estimate the regressions, the standard OLS assumptions need to hold for OLS to be the best linear unbiased estimator. To take into account the homoskedasticity assumption, the returns are transformed to the logarithm of the returns. The calculation of the returns will be as follows:

$$Return_t = (\log(P_t) - \log(P_{t-1})) * 100$$

As the data is transformed to the logarithm of the returns, an overview of these data is found in table 1.2. In appendix 2 (figure 2.1 to 2.5), a graphical representation of the data can be found. As the return of each day is calculated by subtracting the logarithm of the return of time t-1 by the logarithm of the return of time t, the first day of each dataset drops in the dataset of the log returns. Therefore, the dataset for the log return always has one observation less than the dataset of the stock prices (table 1.1). For the entire dataset of all indexes, a constant number of 1509 observations is found.

Variable	Obs	Mean	Std. Dev.	Min	Max
US Total Market	1509	.03604	.83412	-4.06667	4.83553
US Mega Market	1509	.03843	.82930	-4.26724	4.91414
US Large Market	1509	.03747	.82839	-4.15483	4.85146
US Mid Market	1509	.03261	.85709	-4.24861	4.54161
US Small Market	1509	.02748	.93625	-3.90963	4.80202

Table 1.2: Summary of the statistics of the logarithm return data of all markets inquired.

Methodology

To test the different hypotheses, t-tests are used to identify differences between the control period and the test period.

With regards to the January effect, the following regression will be ran:

$$Return_t = a + b * Dummy_{January} + u_t$$

In this regression the dummy variable $Dummy_{January}$ takes the value 1 if the day is in January. If the day falls in another month than the month of January, this dummy will have a value of 0.

The regression for the turn-of-the-month effect takes on an almost similar form as the regression for the January effect:

$$Return_t = a + b * Dummy_{TurnPeriod} + u_t$$

In this regression, the dummy variable *TurnPeriod* has a value of 1 if the day is either the last day of the previous month or if it is one of the first three days of the following month. Schematically that would come to the notation [-1, +3].

For the regression with regards to the end-of-December effect, the following is used:

$$Return_t = a + b * Dummy_{SecondHalf} + u_t$$

In this regression, the dummy variable *SecondHalf* is assigned to the value of 1 if the date is the 17th of December up and until the 31st of December and the value of 0 if the date is the 1st of December up and until the 16th of December. This way, exactly the first half and the second half of December will be captured in this dummy variable.

Lastly, the regression for the weekend effect will look the following:

$$Return_t = a + b * Dummy_{Monday} + u_t$$

For this regression, the dummy variable $Dummy_{Monday}$ has a value of 1 if the day is a Monday and 0 if it concerns any other day of the week.

Results

January effect

In table 2.1, one can find the results for the regression for all the different indexes with regard to the January effect.

	Constant	January	T-stat
Total US Market	0.0364	-0.0041	-0.05
Mega US Market	0.0392	-0.0092	-0.12
Large US Market	0.0378	-0.0045	-0.06
Mid US Market	0.0312	0.0171	0.21
Small US Market	0.0270	0.0061	0.07

*Table 2.1: Regression results for the January effect among the different indexes from 01/01/2014 – 01/01/2020. *10% significance, **5% significance, ***1% significance*

The regression results show that for none of the indexes statistical evidence is found for the January effect. None of the returns of the different indexes is significantly different in the month of January relative to all other months during the year. This is in line with the conclusions of former research that the January effect has vanished from all stock markets around the world.

Turn-of-the-month effect

In table 2.2 the results of the regression for the turn-of-the-month effect are presented.

	Constant	TOTM	T-stat
Total US Market	0.0439	-0.0414	-0.76
Mega US Market	0.0468	-0.0438	-0.81
Large US Market	0.0454	-0.0414	-0.76
Mid US Market	0.0383	-0.0299	-0.53
Small US Market	0.0348	-0.0387	-0.63

*Table 2.2: Regression results for the Turn of the month effect among the different indexes from 01/01/2014 – 01/01/2020. *10% significance, **5% significance, ***1% significance*

With regards to the regression for the Turn-of-the-month effect we conclude that it has no significant power for any of the five indexes inquired. This is not in line with the research done over past decades.

End-of-December effect

In table 2.3 the results for the regression of the End-of-December effect are presented.

	Constant	End-of-December	T-stat
Total US Market	-0.1031	0.1020	0.56
Mega US Market	-0.0775	0.0688	0.37
Large US Market	-0.0896	0.0832	0.45
Mid US Market	-0.1512	0.1571	0.86
Small US Market	-0.1932	0.2171	1.12

*Table 2.3: Regression results for the End-of-December effect among the different indexes from 01/01/2014 – 01/01/2020. *10% significance, **5% significance, ***1% significance*

The results from the regression for the End-of-December effect shows no significant higher returns during the second half of December relative to the first half of this month. As well as for the Turn-of-the-month effect, this is not in line with recent research.

Weekend effect

In table 2.4 the results for the regression of the Weekend effect are presented.

	Constant	Weekend	T-stat
Total US Market	0.0501	-0.0747	-1.36
Mega US Market	0.0509	-0.0665	-1.22
Large US Market	0.0510	-0.0717	-1.31
Mid US Market	0.0508	-0.0968*	-1.72*
Small US Market	0.0449	-0.0926	-1.50

*Table 2.4: Regression results for the Weekend effect among the different indexes from 01/01/2014 – 01/01/2020. *10% significance, **5% significance, ***1% significance*

The weekend effect shows a significant result for the the Mid US Market only on the 10% level. On the Mid US Market, Mondays on average have a 9.68% lower return than on all other days. All other indexes show no significantly lower returns on the Mondays.

Conclusion

In this paper, research is conducted on the existence of the January effect, the Turn-of-the-month effect, the End-of-December effect and the Weekend effect on the congregated US stock market. These four calendar anomalies are tested on five different indexes: Total US Market, Mega US Market, Large US Market, Mid US Market and Small US Market. Over the period of 01/01/2014 to 31/12/2019 the data is analysed. Furthermore, the use of the logarithm of the returns prevents outliers from influencing the sample too much. The four calendar anomalies are tested by using dummy variables and t-tests.

The first calendar anomaly that is inquired, the January effect, seems to have disappeared from the US stock market all together. For none of the five different indexes, a significant rejection from the null-hypothesis is recorded. Therefore, the null-hypothesis, that states that there is no significant difference in the returns of the month of January relative to the returns of all other months, can't be rejected. This conclusion is in line with research by Cooper, McConnell & Ovtchinnikov (2006), Mehdian & Perry (2002) & Gu (2003) who all came to the same conclusion that the January effect has completely disappeared from stock markets around the globe.

The Turn-of-the-month anomaly showed similar results as the January effect. For none of the five indexes, a significant deviation from the null-hypothesis is recorded. This is noteworthy as this is not in line with research done by McConnell and Xu (2008) as they concluded that for non-US markets and for US markets specifically, a significant result was found in favour of the Turn-of-the-month effect. This result was not solely devoted to small markets, but also to larger markets. It is therefore remarkable that in this paper no statistical evidence was found for this particular calendar anomaly on the US markets.

Furthermore, the End-of-December effect shows no statistical evidence of its existence either. This is not in line with recent research conducted by Van der Sar and Dröge (2000) and Van der Sar (2003). All these papers concluded that for the majority of the markets inquired, a significant result was found in favour of the existence of the End-of-December effect.

Lastly, the Weekend effect. The Weekend effect is the only calendar anomaly that shows a significant result. For the Mid US Market, a significant result on the 10% level is observed. This is partially in line with the research of research by Van der Sar and Dröge (2000), as they concluded that the Weekend effect has completely disappeared from the US stock markets. However, it is not in line with the research of Boudreaux, Rao and Fuller (2010) who concluded that this anomaly is present on the US stock markets in non-bearish markets.

This research shows that the overwhelming majority of the calendar anomalies has disappeared from US stock markets. For further research, one could research many more calendar anomalies or the calendar anomalies that were a further development of certain anomalies researched in this paper. For example, the Other January effect would be a good option in this retrospect. Furthermore, one could argue that the testing period of 2014 – 2019 is too short and that there should have been tested for structural breaks over a longer period. As some of the anomalies come and go with bearish and bullish markets, this would be a good position for future research.

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Appendix

1. Line graph stock data

Figure 1.1: Stock data US Total Market 01/01/2014 – 31/12/2019

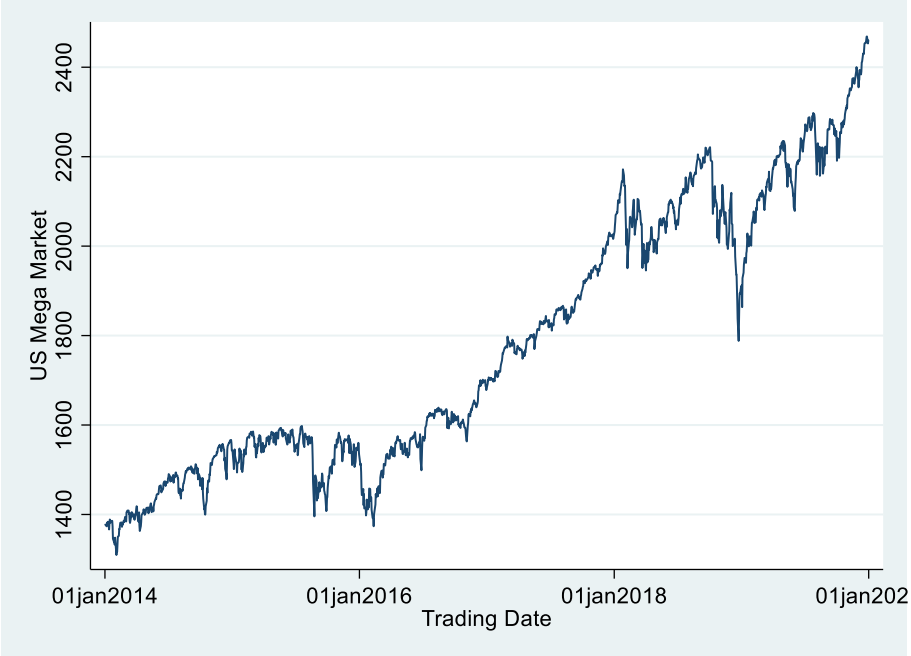

Figure 1.2: Stock data US Mega Market 01/01/2014 – 31/12/2019

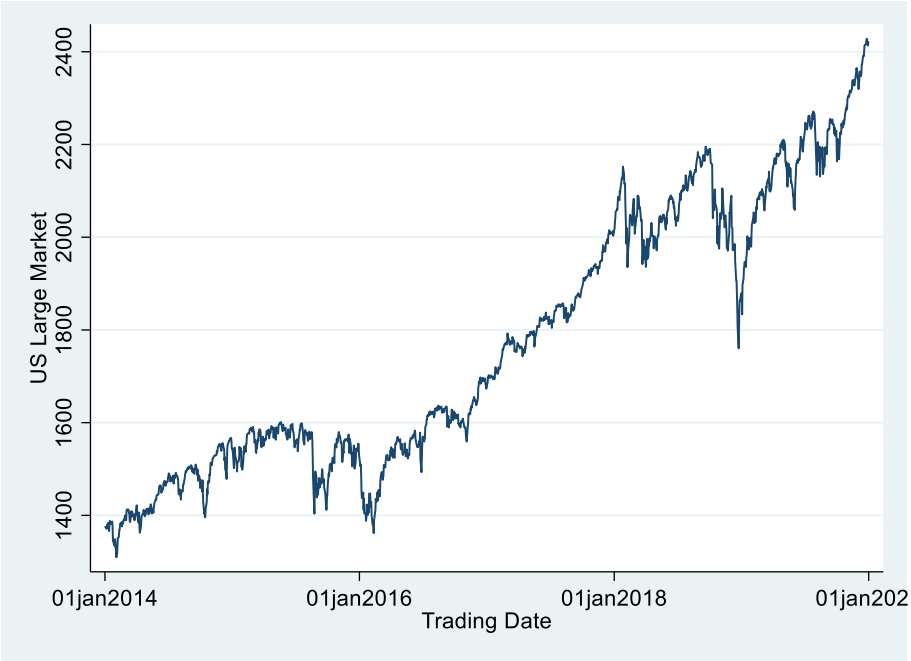

Figure 1.3: Stock data US Large Market 01/01/2014 – 31/12/2019

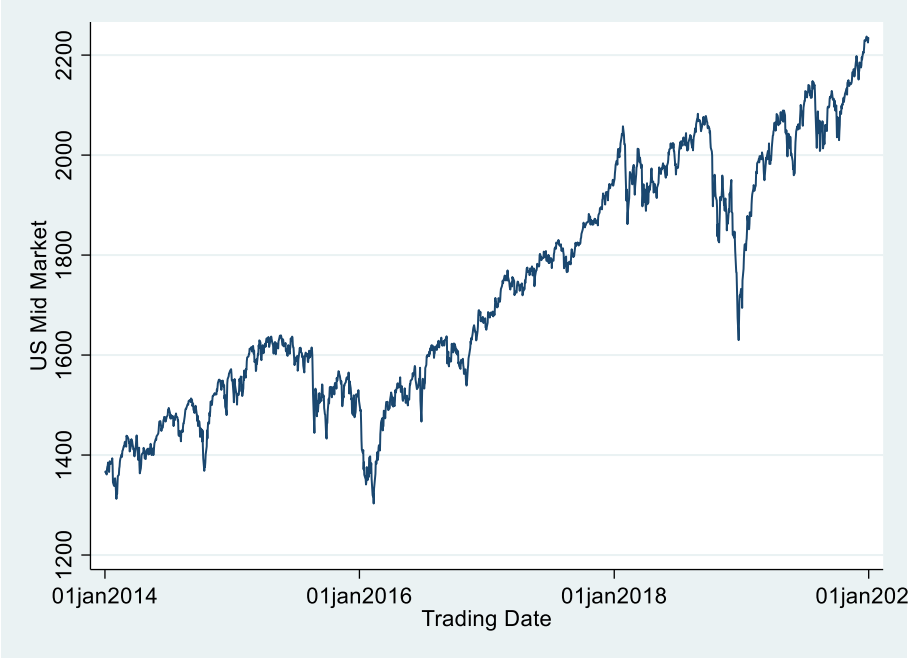

Figure 1.4: Stock data US Mid Market 01/01/2014 – 31/12/2019

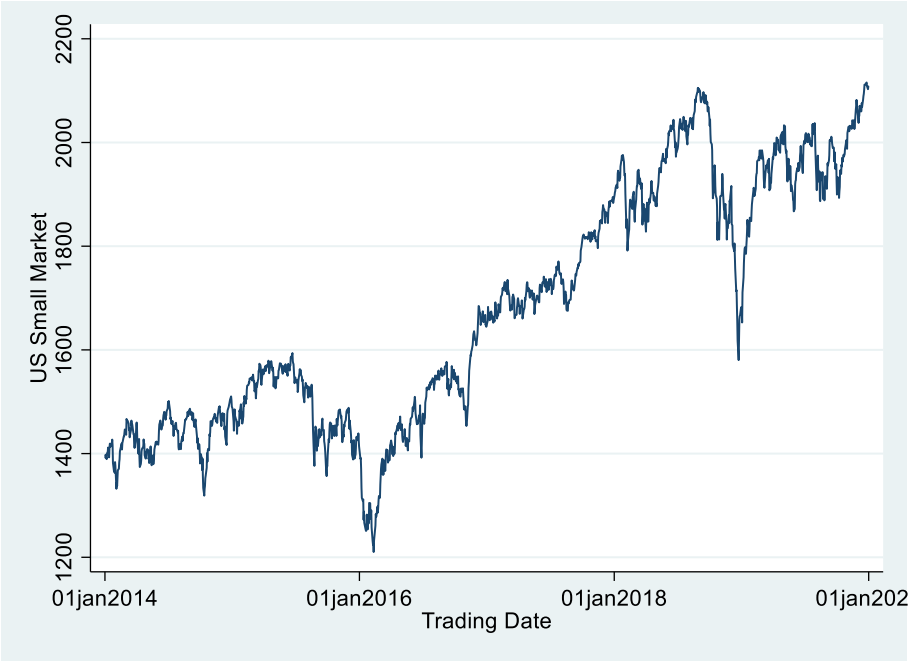

Figure 1.5: Stock data US Small Market 01/01/2014 – 31/12/2019

2. Line graph return data

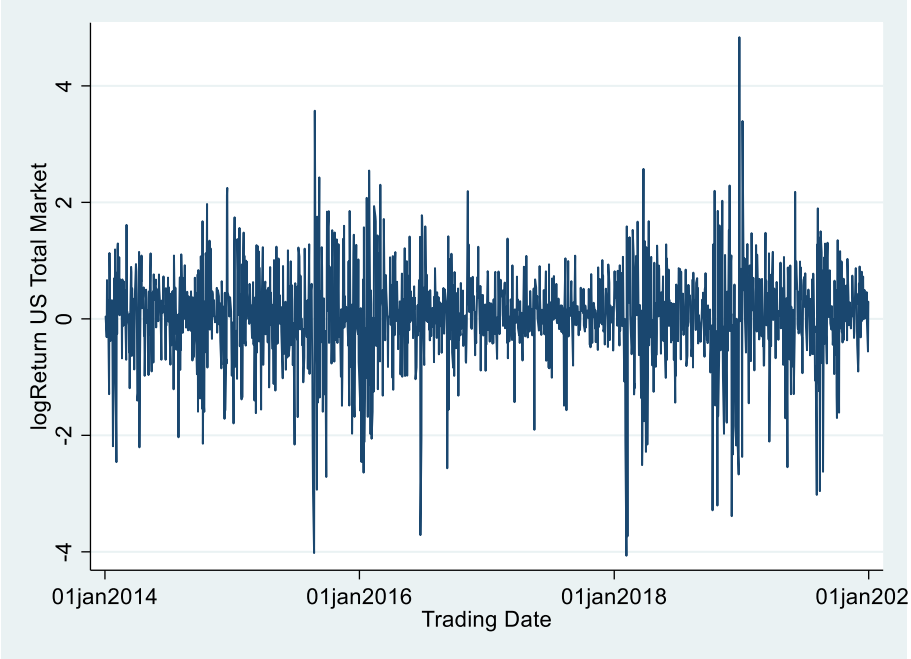

Figure 2.1: Return data US Total Market 01/01/2014 – 31/12/2019

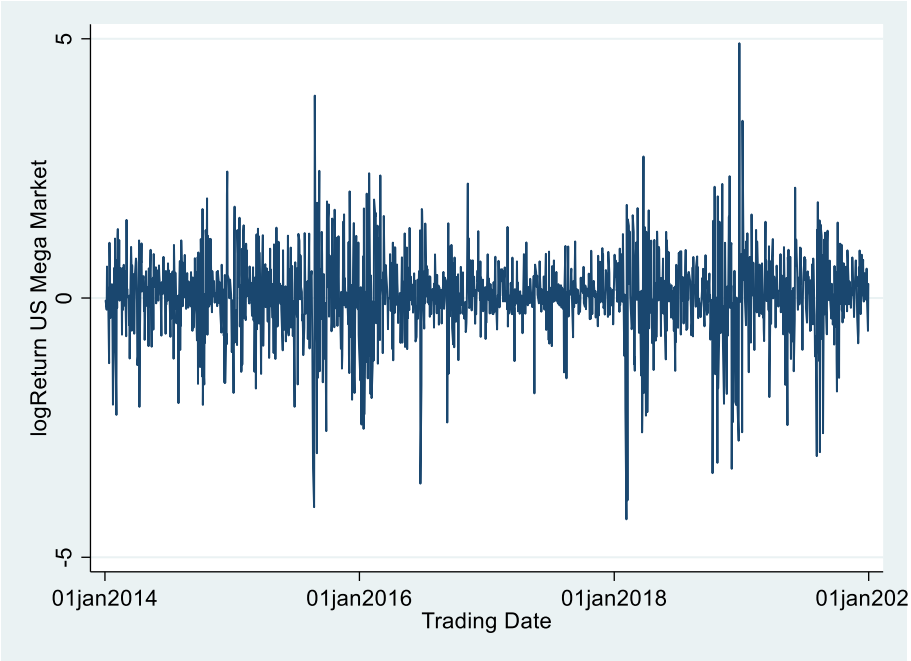

Figure 2.2: Return data US Mega Market 01/01/2014 – 31/12/2019

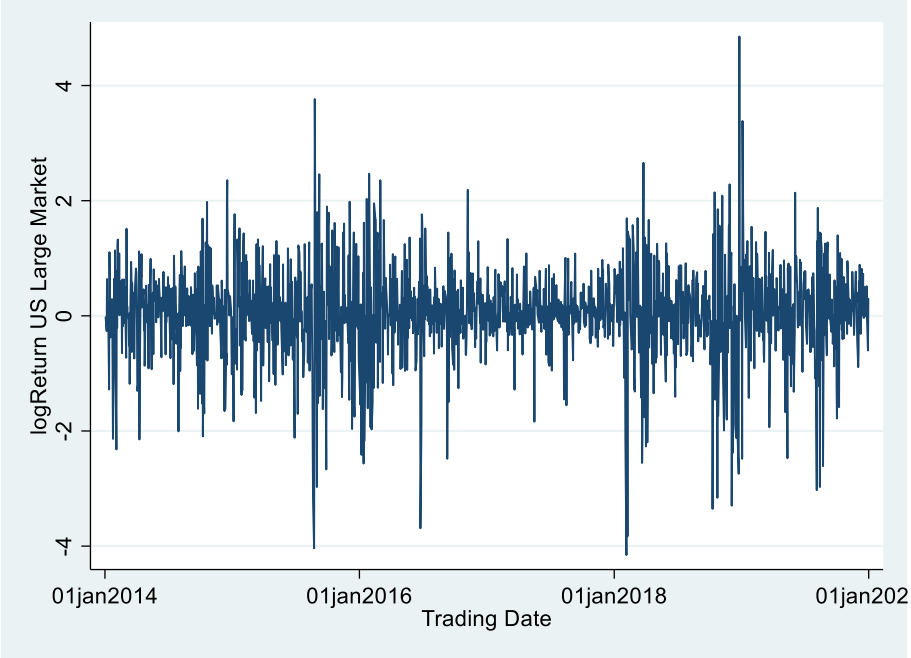

Figure 2.3: Return data US Large Market 01/01/2014 – 31/12/2019

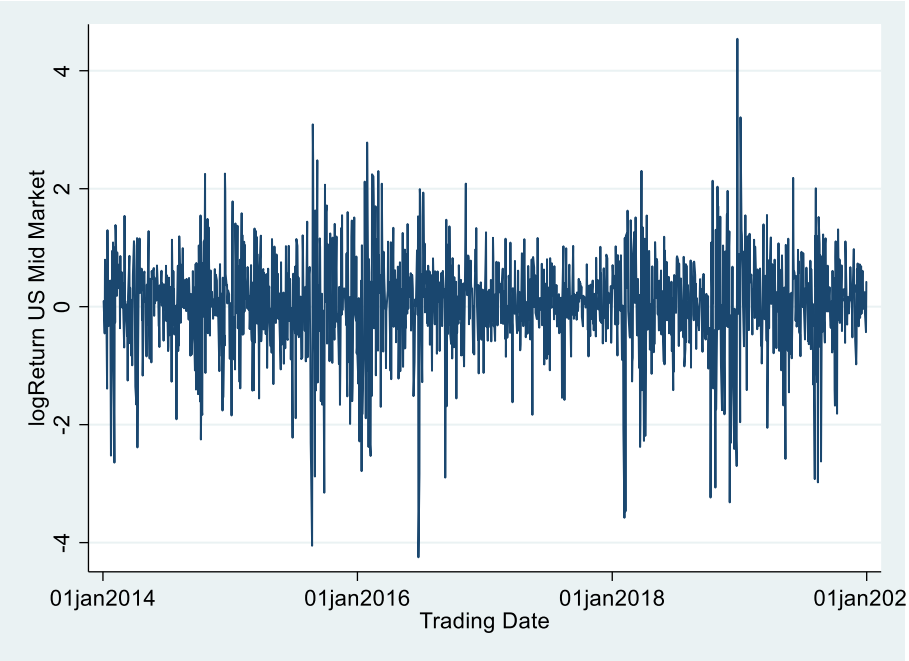

Figure 2.4: Return data US Mid Market 01/01/2014 – 31/12/2019

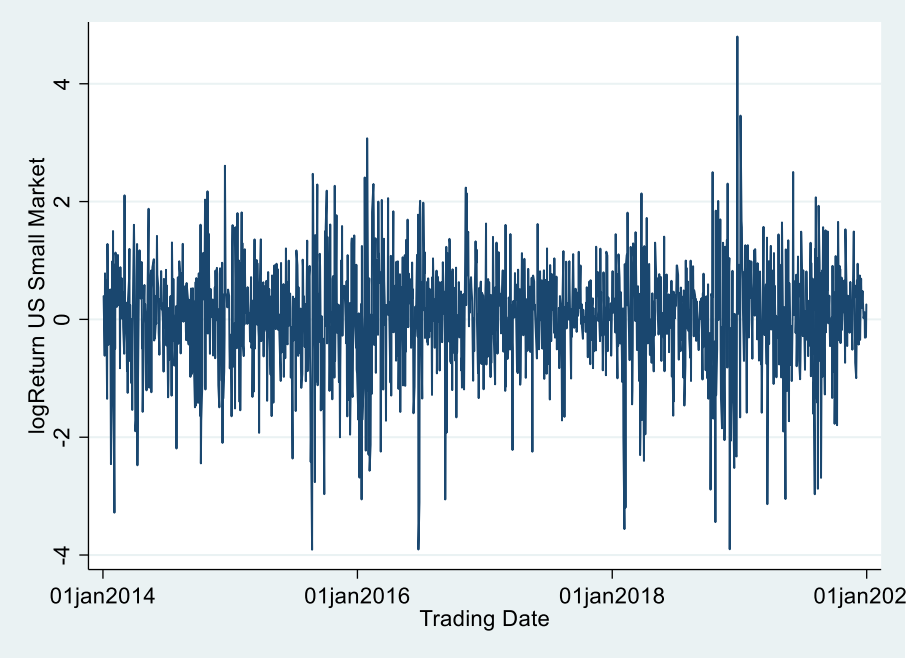

Figure 2.5: Return data US Small Market 01/01/2014 – 31/12/2019