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Short-term underreaction in response to earnings announcements

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Abstract

In this paper under- or overreaction in response to earnings announcements will be researched. This will be done by looking at 50 of the biggest American companies in the period from 1983 until 2018. The under- or overreaction will be measured over a short period of ten days after the announcement. We find evidence of underreaction in response to positive price shocks. For negative price shocks there is a short underreaction which is quickly reversed within ten days. It also becomes clear that the size of the price shock has no real effect on the post earnings announcement drift. Furthermore, there are some differences between different time periods but there does not seem to be a clear trend.

1. Introduction

According to the Efficient Market Hypothesis (EMH), stock prices contain all information available. This means that it should be impossible to predict future price movements. Whenever companies publish their quarterly results they release new information. In this case the EMH states that the price of the stock will move to the 'right' price immediately. So according to the EMH, the stock price at the end of a day should include the information of the earnings announcement earlier that day. If this is the case then there would be no real price drift in the days after the earnings announcement. However, other research seems to suggest that this price drift does exist. A positive post earnings announcement drift is also known as underreaction, while a negative drift is known as overreaction. Underreaction is the case where investors underreact to new information. This leads to a smaller initial price movement after the release of new information, than it should have been according to the EMH. This difference between the actual price movement and the predicted price movement by the EMH is then corrected for in the following days. When it comes to overreaction the exact opposite is true. In this case the initial price movement is larger than it should have been according to the EMH. This price movement is then reversed in the following days to arrive at the right price.

This paper will try to answer the following research question: "Is there a post earnings announcement drift present in response to the announcement of earnings reports". This research is done to test the Efficient Market Hypothesis. The EMH used to be the most popular view when it came to the explanation of market prices. However, in the last years there has been more and more proof against the EMH (Malkiel, 2003). This paper tries to provide evidence against the EMH by proving that there exist some cases where stock returns are predictable.

In this paper under- and overreaction will be measured over a short period of maximum 10 days. This will be done by looking at the 50 biggest companies in the United states over the period of 1983 until 2018. Differences in time periods will also be examined to see if any discovered effect changes over time. In this paper we find some evidence of underreaction in response to earnings announcements. This is particularly the case when it is in response to positive price movements. For negative price movements the underreaction is a more temporary effect which is reversed shortly thereafter. When it comes to the different time

periods there is no real trend visible in the post earnings announcement drift. However, the effects are the largest in the period from 1998 until 2003.

This paper will contribute to previous research on this topic. First of all, this paper makes use of a period of 35 years. This period is longer than most of the other researches on this topic. A longer period makes it possible to investigate whether the results change over time. Contrary to one of the papers about short term underreaction by Lasfer, Melnik and Thomas (2003), this paper will look at individual stock prices instead of market indexes. Most of the other papers about short term under- or overreaction (Cox & Peterson, 1994; Lasfer, Melnik, & Thomas, 2003) focus on price movements that were not caused by any specific event. This paper does focus on price shocks caused by a specific event which are the earnings announcements. As this research will point out, there could be significant differences in responses to price shocks caused by different events. The rest of this paper consists of a brief summary of the relevant literature, followed by a description of the data and methodology. The results will be given next, followed by a conclusion.

2. Literature review

Lasfer, Melnik and Thomas (2003) researched in their paper how market indexes would react to a price shock. They defined a price shock in the same way as it will be done in this research. Daily returns on market indexes were indicated as price shocks whenever the return was larger than two standard deviations of the daily returns, measured over a 50-day period ending ten days before the measurement date. The research period spans from 1989 until 1998. They looked at the differences between market indexes of different countries, where they mainly focused on the difference between developing and emerging countries. The main findings in this paper were that there was a positive post-price shock drift for positive shocks. This was the case for both developed and emerging markets although the effect was significantly bigger for emerging markets. For negative shocks there seems to be no real effect for developed markets. For emerging markets however, there is an underreaction just like there is when the price shock is positive.

Daniel, Hirshleifer and Subrahmanyam (1998) investigated underreaction and overreaction with the use of the correlation between post announcement earnings and the price shock. They found evidence that there has been over and underreaction but lacked the power to predict these events. The theory about under- and overreaction that they developed was that investors overreact to private information signals and underreact to public information signals.

In the study of Cox and Peterson (1994), price declines of 10% per day and their post decline drift for American companies in the period from 1963 until 1991 were researched. They find significant reversals confirming the overreaction theory. These reversals did change over time. Also, smaller firms have a bigger reversal than bigger firms. However, there is a lack of correlation between the decline date and post decline date returns, maybe caused by the bid ask spread. In the long term, they find that there is a significant underreaction in response to price declines. They also find differences in the effect between different time periods.

Dellavigna and Pollet investigate whether returns following earnings announcements differ when the announcement occurs on different days of the week (Dellavigna & Pollet, 2009). They especially focus on announcements on Friday. They want to test the hypothesis that there is less investor's attention on Fridays, which causes a greater underreaction to earnings announcements than on other weekdays. Their main findings are that the immediate response, the return on the day of the announcement, on Fridays is 15% lower than on other days. This in combination with a 70% higher delayed reaction for Fridays. This means that due to less attention from investors on Fridays, an underreaction effect was caused.

3. Data and Methodology

For this research the daily stock returns of the biggest American companies are used. To test if the post-earnings announcement date drift changes over time, the stock returns of the last 35 years are used. This means that the period spans from January 1983 until and including December 2017. To obtain the same number of events in every time period, only companies which were publicly listed since 1983 were used. With the use of Orbis, the 50 biggest companies, according to revenue, which were listed since 1983 are determined. A list of the different companies used in this research is given in Table 1. During the period of 35 years a couple of companies have merged with other companies or acquired other firms. In these cases, only the companies with matching CUSIP identification numbers are used. So, for example when two companies merge somewhere during the 35-year research period, only the company with the same CUSIP number as the company in 2017 will be incorporated in the sample for the years prior to the merger. The stock returns of the 50 companies were obtained from The Center For Research in Security Prices (CRSP) while the announcement dates of earnings reports came from Compustat.

To test if there is a post earnings announcement drift there needs to be a benchmark to compare stock returns with. In this paper, the daily S&P 500 return is used as benchmark. First a beta for each company is calculated to measure the correlation between the S&P 500 and each company. This is done by running a regression between each stock's daily return and the daily S&P 500 return where the daily risk-free rate is subtracted from both returns. The risk-free rate is taken according to Fama and French (French & Kenneth, 2018). The abnormal return AR_{it} of stock *i* at day *t* is calculated as following:

$$(1)\ AR_{it} = R_{it} - \beta_i * RM_t$$

Where R_{it} is the return of stock *i* at day *t*, β_i is the calculated beta for stock *i* and RM_t is the return of the S&P 500 at day *t*. The abnormal returns are used in the determination of price shocks and the calculation of the Cumulative Abnormal Return (CAR). The CAR is the compounded sum of abnormal returns. This is done for one to ten days after the price shock. The 3-day CAR for example, equals the compounded sum of returns of the first three days after the event.

To research if there is a post-earnings announcement drift there first must be a significant price shock at the date of the earnings announcement. For the determination of a price shock, differences in volatility of different companies need to be considered. This is done by calculating the standard deviation over the period of 45 to 5 days prior to the announcement

Table 1: Summary statistics per company

Company	Min. shock	Max. shock	Positive shock		Negative shock	
			N	Mean	N	Mean
3M CO	-6.60	7.01	39	3.37	40	-3.46
ABBOTT LABORATORIES	-9.70	6.76	23	3.43	29	-3.50
ALTRIA GROUP INC	-13.63	10.14	18	3.16	22	-3.31
AMERICAN EXPRESS CO	-14.93	18.30	34	3.88	32	-3.92
AMERICAN INTERNATIONAL GROUP INC	-15.63	18.65	30	3.78	31	-4.63
ANDEAVOR	-20.81	15.08	16	6.52	25	-7.38
APPLE INC	-22.16	21.92	47	7.42	38	-7.24
ARROW ELECTRONIC INC	-12.44	14.88	41	6.43	21	-5.19
BANK OF AMERICA CORP	-18.22	7.27	25	3.73	28	-4.84
BOEING CO	-11.81	14.78	35	4.66	31	-4.25
CATERPILLAR INC	-14.65	10.28	41	4.48	33	-4.86
CHEVRON CORP	-7.27	5.37	20	3.04	21	-3.07
COCA COLA CO	-8.25	7.87	34	3.13	29	-3.16
COMCAST CORP	-10.67	9.54	30	4.85	18	-4.58
CONOCOPHILLIPS	-8.70	5.53	19	3.28	17	-3.30
CVS HEALTH CORP	-21.70	12.53	35	4.71	18	-6.63
DEERE & CO	-10.31	13.63	40	5.41	39	-4.67
DISNEY WALT CO	-19.86	13.47	34	4.25	31	-4.94
EXXON MOBIL CORP	-5.95	4.79	12	2.76	33	-2.75
FEDEX CORP	-12.67	14.56	49	5.23	35	-5.11
FORD MOTOR CO	-12.57	11.96	27	5.26	29	-4.58
GENERAL DYNAMICS CORP	-11.65	6.90	42	3.70	26	-3.46
GENERAL ELECTRIC CO	-11.39	14.47	20	3.48	29	-3.54
HOME DEPOT INC	-12.46	9.39	35	3.99	28	-4.39
HONEYWELL INTERNATIONAL INC	-7.19	6.05	34	3.31	22	-3.58
HP INC	-18.25	19.72	38	7.67	42	-7.10
INTEL CORP	-14.78	14.87	33	5.31	33	-6.29
INTERNATIONAL BUSINESS MACHS CORP	-15.00	12.19	45	4.65	49	-4.66
JOHNSON & JOHNSON	-3.80	5.32	33	2.83	24	-2.36
JPMORGAN CHASE & CO	-6.92	11.81	24	3.72	25	-2.99
KROGER COMPANY	-24.13	11.41	44	5.17	35	-6.79
LEUCADIA NATIONAL CORP	-14.40	8.83	11	4.99	18	-4.55
LILLY ELI & CO	-9.63	6.84	18	2.88	31	-3.59
LOCKHEED MARTIN CORP	-13.81	8.17	29	3.88	33	-3.82
LOWES COMPANIES INC	-19.57	8.96	39	5.19	28	-5.00
MERCK & CO INC	-8.39	10.31	34	3.45	24	-3.62
NIKE INC	-11.56	11.75	48	6.53	34	-5.03
NORTHROP GRUMMAN CORP	-13.21	7.43	34	3.73	24	-3.43
PEPSICO INC	-11.57	13.71	45	3.10	26	-3.44
PFIZER INC	-10.80	7.02	28	3.55	28	-4.19
PROCTER & GAMBLE CO	-8.61	5.93	37	2.96	34	-3.29
RAYTHEON CO	-7.49	11.36	32	4.19	23	-3.20
SYSCO CORP	-8.30	10.40	33	4.34	29	-3.75
TARGET CORP	-11.90	8.96	30	4.34	25	-5.10

TYSON FOODS INC	-15.04	11.27	30	5.60	32	-6.20
UNITED TECHNOLOGIES CORP	-6.63	8.51	41	3.64	28	-2.79
VALERO ENERGY CORP	-7.19	13.41	24	6.53	15	-4.53
WAL MART STORES INC	-7.95	10.19	31	4.33	29	-3.26
WALGREENS BOOTS ALLIANCE INC	-16.06	11.01	29	4.52	34	-4.91
WELLS FARGO & CO	-6.14	29.78	22	5.96	26	-2.92
Total	-24.13	29.78	1592	4.50	1434	-4.42

date for each company. To determine if there is a price shock at the time of an earnings announcement, the absolute value of the excess return of that day minus the average excess return in the (-45 to -5) period should be higher than 2 standard deviations of the returns measured over the (-45 to -5) period. This is done to cope with differences between companies but also with differences in time periods. This method prevents that there are too many price shocks in volatile times like financial crises. The lower bound of 45 days prior to the announcement days is taken because it will cause the least interference with earlier earnings announcements, due to the fact that these usually happen in a three-month cycle. The upper bound of 5 days is chosen to incorporate the fact that stock returns could be more volatile prior to earnings announcements due to speculation.

There is an issue with the earnings announcement dates. Compustat gives the right report dates, but does not mention if the announcements were released before or after the stock market is open. This means that it is unclear whether the stock market reacts to the news on the reporting date or the day after. To solve this issue, first it is tested if the excess return on the report date can be seen as a price shock. When this is not the case the same is done for the day after the reporting date. The price shock that happens on the first of these two dates will be regarded as the actual price shock caused by the earnings announcements. However, this method could lead to the inclusion of price shocks that are not caused by earnings announcements. Price shocks occurring on the reporting date when the earnings announcement only happens after the market closes, lead to an incorrect inclusion of a price shock. The same thing occurs when earnings are reported before the market opens and cause no price reaction, while some other event causes a price shock on the day after the announcement. These events could lead to a bias in the results. However, even if the date and precise time of the announcement was known, it could still lead to a bias when a price shock occurs at the announcement date but was caused by some other event. To see if this method does not lead to a bias, a test is performed to see if the price reaction of price shocks which happen on the report date, is the same as the price shocks which happen on the day after the report date. This is done for the 1-day CAR until the 10-day CAR and the price shock itself. When the positive shocks are examined it is found that the price shock does not differ significantly between the two groups. The CARs of all the ten days are higher for the report date than for the day after the report date. However, only in the 2-day CAR this difference is a significant one. For the negative shocks there is a little significant difference between the price shocks, but there is no real difference between 1-day until 10-day CAR. Despite these little differences it will be assumed that the price shocks on both dates were caused by the

Table 2: Summary statistics per time period

Year	Max shock	Min shock	Positive shock		Negative shock	
			N	Mean	N	Mean
1983-1988	14.78	-19.86	91	4.26	98	-4.29
1988-1993	13.92	-19.57	146	4.55	109	-4.33
1993-1998	21.92	-22.16	217	4.86	146	-4.07
1998-2003	19.72	-24.13	222	5.90	170	-6.74
2003-2008	13.47	-16.06	306	3.94	268	-3.90
2008-2013	29.78	-21.59	275	4.61	315	-4.47
2013-2018	17.44	-18.73	335	3.81	328	-3.81
Total	29.78	-24.13	1592	4.50	1434	-4.42

reporting of earnings announcements.

The amount of earnings report dates of 50 companies measured over 35 years are 7000. On 3026 report dates there was a price shock, which was a positive shock in 1592 cases and a negative shock in 1434 cases. Table 1 gives the summary statistics for each company. The maximum positive price shock in the sample was 29.78% while the minimum negative price shock was -24.13%. On average each company had 60.5 price shocks during the research period. The minimum number of price shocks per company was 29, while the maximum number of price shocks was 94. The total number of price shocks of 3026 meant that a price shock occurred on 43.23% of the reporting dates of earnings announcements. The total period of 35 years was divided into seven groups of five years. The summary statistics for each time period is given in table 2. The first thing that becomes clear of these statistics is that the number of price shocks increases as time passes. During the period of 1983 until 1988 there was a price shock in 18.9% of the earnings report dates. This percentage steadily climbed to 66.3% in the period of 2013 until 2018. This difference will be further investigated in the results section mainly by looking at differences in volatility.

To test the main hypothesis that there is a post earnings announcement drift, a t-test is performed on each CAR to see if they significantly differ from zero. This is done separately for positive and negative shocks. The hypotheses are:

H0: mean of CAR = 0 Ha: mean of CAR ≠ 0

Furthermore, a regression is run for each CAR against the size of the price shock and the different time periods. This is to test if the size of a price shock has an effect on the post earnings announcement drift. It is also used to test if there are differences between time periods. Besides the variables for the size effect and the different time periods, a control variable measuring the standard deviation in the period preceding a price shock will be used.

Table 3: Mean of CARs for positive and negative shocks

	Positive shocks			Negative shocks	
	Mean	T-value		Mean	T-value
Price shock	4.504***	64.56		-4.418***	-56.01
CAR1	0.315***	5.26		-0.252***	-3.81
CAR2	0.408***	5.93		-0.210***	-2.86
CAR3	0.445***	5.65		-0.199***	-2.49
CAR4	0.566***	6.70		-0.256***	-2.86
CAR5	0.609***	6.83		-0.243***	-2.55
CAR6	0.716***	7.55		-0.212**	-2.09
CAR7	0.765***	7.59		-0.171*	-1.61
CAR8	0.825***	7.84		-0.149*	-1.31
CAR9	0.900***	7.97		-0.062	-0.52
CAR10	0.900***	7.72		-0.018	-0.14

The t-values are the result of a t-test of the CARs mean against a zero mean. *,**,*** significant at 0.10, 0.05 and 0.01 levels respectively.

4. Results

Firstly, a t-test is performed on each CAR for both positive and negative shocks. The results are given in Table 3. For positive shocks the 1-day CAR is significantly positive. This means that on average a positive price shock is followed by a one day return of 0.315%. This positive return of the first day keeps on increasing in the following days where each CAR is also significantly positive. This means that there is a positive post-earnings announcement date drift, or to put it differently, there is underreaction in response to earnings announcements. The price movement is the biggest on the first day after the report date. However, the difference between the 10-day CAR and 1-day CAR is also a significant difference meaning that the underreaction is not only present on the first day but during the entire 10-day period. When it comes to the negative shocks there is a first indication that, like the positive shocks, underreaction is present. The 1-day CAR is -0.252% and significant, indicating underreaction. However, unlike the positive shocks the CARs of the following days do not move in the same direction as the price movement of the first day. The CARs of day 2 until day 6 are reasonably stable around the 1-day CAR level. Until the sixth day each CAR is significantly lower than zero. Starting from day seven however, the mean of the CARs decreases to a value of -0.018 on the tenth day. This means that for negative price shocks there is a brief negative post earnings announcement drift which is reversed within ten days after the earnings announcements. These results show that the market underreacts to earnings announcements when the information is positive. When there is negative information, there is a short underreaction which reverses shortly after the announcement.

So far price shocks occurring at earnings announcements and their post earnings announcement drift have been examined. This showed a positive post earnings announcement drift for positive shocks and a more temporary effect for negative shocks. While these results prove that there is a post announcement drift for earnings announcements, they do not prove that the post announcement drift is caused by the

Table 4: Mean of CARs for positive and negative shocks in respons to other events

	Positive shocks			Negative shocks	
	Mean	T-values		Mean	T-values
Car1	0.084***	4.35		0.061***	2.74
Car2	0.020	0.76		0.174***	5.71
Car3	-0.006	-0.19		0.270***	7.58
Car4	-0.047*	-1.33		0.347***	8.70
Car5	-0.045	-1.24		0.382***	9.12
Car6	-0.037	-0.92		0.416***	9.07
Car7	-0.020	-0.48		0.440***	9.16
Car8	-0.004	-0.09		0.451***	8.96
Car9	0.020	0.44		0.464***	8.72
Car10	0.066*	1.43		0.494***	8.87

The t-values are the result of a t-test of the CARs mean against a zero mean. *,**,*** significant at 0.10, 0.05 and 0.01 levels respectively.

earnings announcements. The research sample is obtained using two requirements. The first is that there must be a price shock and the second is that this price shock should happen on the day that the earnings reports are published. To further understand the post-announcement drift found in this research, it is useful to take a closer look at the two requirements. First it is examined what the effect of earnings announcement on the post announcement drift is. This is done by looking at price shocks that are not caused by earnings announcements. In this case the same sample of companies is used as was used for the earnings announcements, and also the same way of measuring price shocks is used. This means that all the daily returns of 50 companies over a period of 35 years are investigated to see if they match the criteria of a price shock, as was explained in the methodology. This gave a total of 28,592 price shocks of which 3,026 were caused by earnings announcements, leading to 25,566 price shocks caused by other events. Other events could include changes in dividends, share repurchases and any other event where new information is released.

Table 4 gives the means of the CARs after price shocks that were caused by other events for both positive and negative price shocks. The CARs of positive price shocks are significantly different than they were when they were caused by earnings announcements. The CARs of day 2 until day 10 are not significantly different from zero. The 1-day CAR of 0.084% is significantly larger than zero. However, when compared to the 1-day CAR in response to price shocks caused by earnings announcements it is significantly lower. This means that for positive shocks, the event that caused the price shock matters. In this case earnings announcements are the reason for the positive post announcement drift. This is in line with the theory about underreaction. When earnings announcements have informational value, this information is incorporated in its stock price with a delay. When it comes to negative shocks there is a clear post price shock drift. All the CARs are significant and positive and gradually increase to almost 0.5% in ten days. This is a different price movement than the one caused by earnings announcements. Instead of an initial underreaction there is a clear overreaction in this case. The CARs are also significantly different from the CARs with price shocks caused by earnings announcements.

Table 5: Standard deviations per time period

	Return (stdev)*	Stdev (-45 to -5)**	Return/Standard Deviaton***	Number of Price shocks
1983-1988	2.62	1.60	1.21	189
1988-1993	2.95	1.49	1.40	255
1993-1998	3.35	1.42	1.70	363
1998-2003	4.79	2.12	1.78	392
2003-2008	3.56	1.10	2.62	574
2008-2013	4.50	1.40	2.66	590
2013-2018	3.76	0.89	3.41	663

*This Colom gives the standard deviation of all the returns in each period. **This Colom gives average standard deviation used in the period preceding an earnings announcement. ***This Colom gives the average of the absolute value of returns on days when earnings were announced divided by the corresponding standard deviation

The research sample contains a time span of 35 years. To examine if the post earnings announcement date drift changes over time, this period of 35 years is divided into seven periods of five years. The first thing that draws the attention is the number of price shocks in each period. Between 1983 and 1988 there were 189 price shocks while between 2013 and 2018 there were 663 price shocks. This number has steadily increased in every time period. A part of the explanation of why the number of price shocks has increased, could have something to do with the increased standard deviation of the returns. To examine this, it is useful to look at all the returns on days when earnings were announced. The number of earnings announcements in every period is varying between 990 and 1000. Due to some missing values there are not 1000 observations in each period. To see what causes the increase in price shocks, it is also useful to repeat the definition of a price shock. A price shock occurs when the absolute value of the excess return of that day minus the average excess return in the (-45 to -5) period is higher than 2 standard deviations measured over the (-45 to -5) period, where the (-45 to -5) period refers to the period between 45 days before the earnings announcement and 5 days before it. An increase in price shocks could therefore be caused by two things. Firstly, higher absolute values of the excess return, and secondly a lower standard deviation of the daily returns in the preceding period. In the first Colom of Table 5 the standard deviation of the returns for each time period is given. This shows that this standard deviation has increased over time. A bigger standard deviation means that returns further from the mean become more apparent. This partly explains why the number of price shocks has increased. However, this relation alone is not conclusive. The second Colom gives the mean of all the standard deviations used to define a return as a price shock. To clarify, for each earnings announcement report date the daily return is compared with a standard deviation measured from 45 days to 5 days before the report date. The mean of all those standard deviations per period is given in Colom 2. Colom 2 shows that there is no real relation between the standard deviation and time periods and subsequently that there is no relation between this standard deviation and the number of price shocks. It does show that the standard deviation could differ a lot between time periods. Where Colom 1 and Colom 2 alone did not give an explanation why the number of price shocks have increased, combining them will give an explanation. To combine them, the absolute value of each return was divided by the standard deviation measured from 45 days to 5 days before the report date. The mean

Table 6: Regression output for positive and negative price shocks

Positive shocks	CAR1			CAR3			CAR5			CAR10	
N = 1592	Coefficient	T-value		Coefficient	T-value		Coefficient	T-value		Coefficient	T-value
Price shock	-0.054	-1.32		-0.043	-1.00		0.026	0.45		0.014	0.19
St. Dev	0.245	0.89		0.044	0.14		-0.370	-1.14		0.462	0.99
1988-1993	0.009**	2.48		0.009*	1.81		0.007	1.10		0.007	0.85
1993-1998	0.006	1.61		0.006	1.26		0.011*	1.72		0.011	1.46
1998-2003	0.011***	2.76		0.015***	2.75		0.021***	3.20		0.021**	2.52
2003-2008	0.007**	2.01		0.009*	1.83		0.011*	1.76		0.014*	1.78
2008-2013	0.002	0.57		0.003	0.72		0.006	0.93		0.009	1.20
2013-2018	0.006	1.63		0.006	1.32		0.006	0.95		0.011	1.43
Constant	-0.004	-0.89		-0.002	-0.28		0.000	0.05		-0.009	-1.04
Negative shocks	CAR1			CAR3			CAR5			CAR10	
N = 1434	Coefficient	T-value		Coefficient	T-value		Coefficient	T-value		Coefficient	T-value
Price shock	0.040	1.02		0.015	0.35		0.055	1.12		-0.005	-0.09
St. Dev	-0.425	-1.39		-0.255	-0.81		-0.194	-0.52		-0.159	-0.30
1988-1993	-0.005	-1.12		-0.002	-0.47		-0.004	-0.61		-0.009	-1.25
1993-1998	-0.002	-0.47		-0.004	-0.78		-0.005	-0.92		-0.012*	-1.69
1998-2003	-0.003	-0.72		-0.003	-0.63		-0.002	-0.37		-0.005	-0.67
2003-2008	-0.006	-1.45		-0.007	-1.41		-0.005	-0.93		-0.012*	-1.85
2008-2013	-0.007*	-1.65		-0.010*	-1.90		-0.006	-0.99		-0.010	-1.44
2013-2018	-0.005	-1.24		-0.006	-1.23		-0.005	-0.83		-0.011	-1.59
Constant	0.009*	1.73		0.008	1.29		0.007	0.98		0.011	1.26

The t-values are the result of a t-test of the CARs mean against a zero mean. *,**,*** significant at 0.10, 0.05 and 0.01 levels respectively.

per period of all those numbers is given in Colom 3 of table 5. This return per standard deviation increases in every period just like the number of price shocks increase in every time period. The correlation between these two variables is 0.976, indicating a clear relation between the two variables. This means that in the period from 1983 until 2018 the returns on report dates relative to the standard deviation of daily returns in the preceding period has increased. This resulted in an increase in the number of price shocks.

A regression is run to test if the size of the price shock or the different time periods affects the CARs. The CARs are regressed against the size of the price shock, six time periods and a control variable. The control variable is the standard deviation of a stock at the time of the price shock measured from 45 days before the shock until 5 days before the shock. This is done for the 1-day, 3-day, 5-day and 10-day CAR for both positive and negative shocks. A Breusch-Pagan test is run to test for heteroskedasticity in each model. This turned out to be the case in all the models, which were then modified by using robust errors. The results are given in Table 6. First of all, the R-squared values of all the models are low. The biggest R-squared value in one of the models is only 0.029. The size of the price shock is in all the models insignificant,

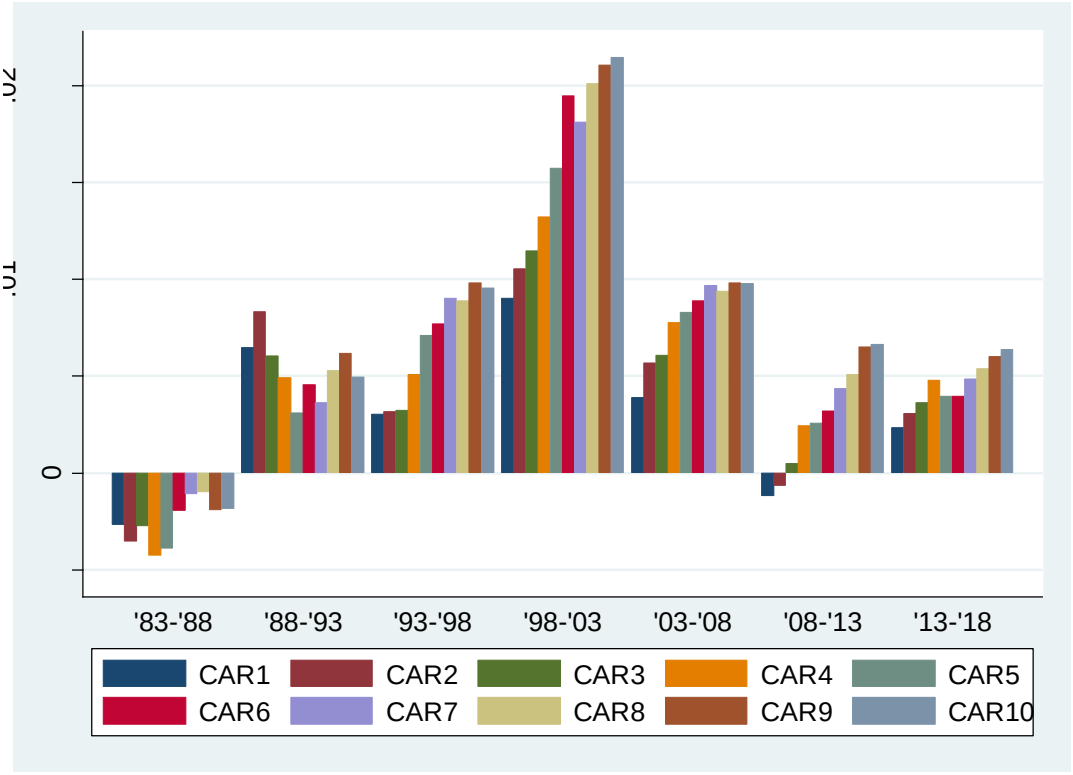

Figure 1: CARs in different periods for positive shocks

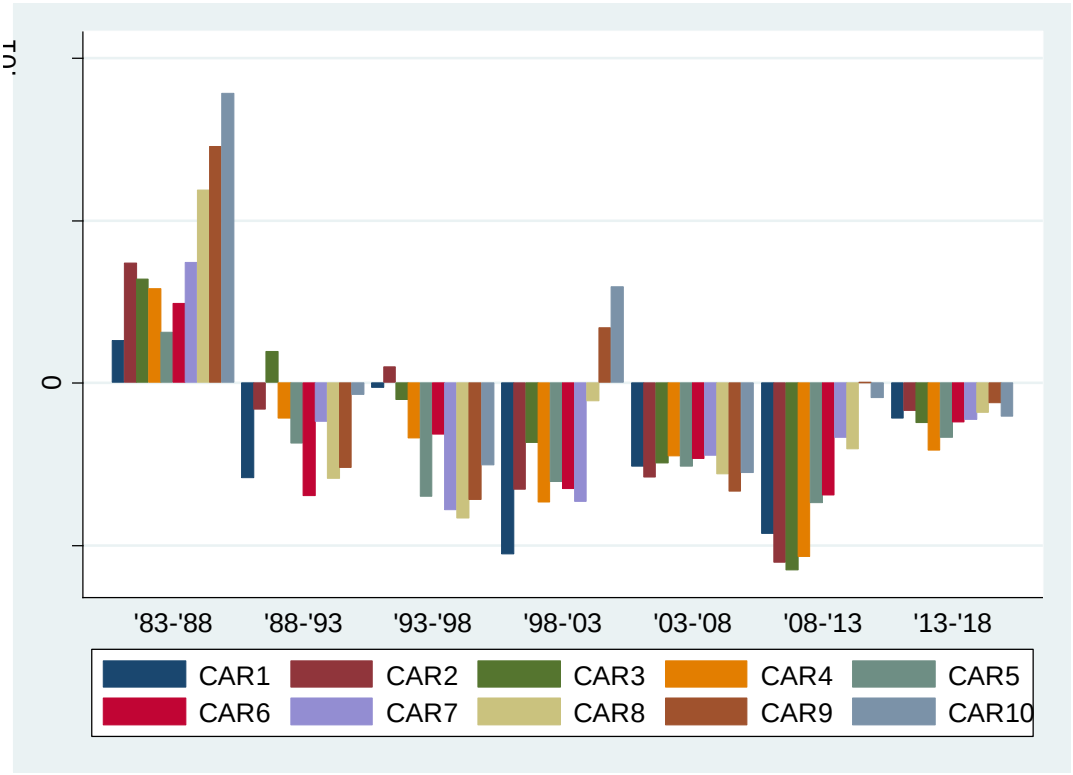

Figure 2: CARs in different periods for negative shocks

meaning that there is no linear relation between the size of the price shock and the CARs. When it comes to the different time periods there is only one clear difference and that is the

period from 1998 until 2003 for the positive shocks. This period is the only period that is significantly different from the first period

In order to take a closer look at the differences between time periods, a bar chart is produced for positive and negative price shocks showing all the CARs in different time periods. These charts are given in figures 1 and 2. Figure 1 shows that in the period from 1998 until 2003 the post price shock drift was the biggest. A possible explanation why this period has the biggest post shock drift, is the tech bubble occurring in that period. During the tech bubble, the volatility on the stock market was big as could be seen in Table 5. This could explain the larger underreaction in that period. The other thing that becomes apparent is that the period from 1983 until 1988 shows the opposite reaction as other time periods. Where the average of the CARs for positive (negative) shocks is positive (negative) for all periods since 1988, this average is negative (positive) for the first period.

5. Conclusion

In this paper the post earnings announcement drift for 50 American companies is researched. Price shocks occurring when earnings reports are announcement are observed, and the price drift following this announcement are then examined. This lead to the conclusion that there is evidence of underreaction. This underreaction was found for positive price shocks. The negative price shocks lead to a smaller initial underreaction lasting for 6 days. However, this underreaction was completely reversed in the following four days.

To test if it was the announcement of earnings reports that caused the underreaction, or that it was just a reaction to a price shock, all price shocks caused by any event other than earnings announcements were also tested. For positive shocks this lead to no real post price shock drift. This meant that it was the announcement of earnings that caused the underreaction. The results for negative price shocks were a bit surprising. Where positive shocks did not show any price drift, and negative price shocks caused by earnings announcements showed some underreaction, the negative shocks showed a significant positive price drift.

This research also showed that the size of a price shock has no influence on the post-price shock drift. There is also no trend visible in the post earnings announcement drift over time. The period from 1998 until 2003 however, shows a higher underreaction in response to positive price shocks.

This paper showed that the Efficient Market Hypothesis does not always hold. Stock prices following earnings announcements could have been predicted and therefore they violate the EMH. This predictability also gave way to a profitable investment opportunity. Although it should be stated that future investment strategies based upon earnings announcements should be done cautiously due to the fact that the underreaction effect seemed to get smaller in the last few years.

Bibliography

Cox, D. R., & Peterson, D. R. (1994). Stock Returns Following Large One-Day Declines: Evidence on Short-Term Reversals and Longer-Term Performance . *The Journal of Finance*, 255-267.

Daniel, K., Hirshleifer, D., & Subrahmanyam, A. (1998). Investor Psychology and Security Market under- and Overreactions . *The Journal of Finance*, 1839-1885.

Dellavigna, S., & Pollet, J. M. (2009). Investor Inattention and Friday Earnings Announcements. *The Journal of Finance*, 709-749.

French, & Kenneth, R. (2018). Retrieved from Dartmouth.edu: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

Lasfer, M. A., Melnik, A., & Thomas, D. C. (2003). Short-term reaction of stock markets in stressful circumstances. *Journal of Banking and Finance*, 1959-1977.

Malkiel, B. G. (2003). The Efficient Market Hypothesis and Its Critics. *Journal of Economic Perspectives* , 59-82.