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Bear Markets and the Three Factor Model

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Abstract

The three factor model that was developed by Fama and French in 1992 aims to explain differences in returns between stocks. This thesis tests whether the sensitivities of S&P500 constituents to the three factors changed during the bear market of 2008. Results show that during the financial crisis, companies became more sensitive to the size premium and value premium. This is most likely due to the magnification of the existing effects as a result of increased uncertainty and risk. Furthermore, adding three interaction effect factors that have the same value during a bear market as the original factors and zero otherwise, increase the explanatory power of the model.

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2. Introduction

In 2008, a massive housing bubble burst in the United States. This caused many subprime mortgage bonds to fail and some states saw homelessness rise by 32% (CBPP, 2009). Furthermore, this kindled a worldwide recession and caused the value of the S&P500 to be cut in half within a years' time. Very few people saw this coming, despite similar events happening in the past. One example is the dotcom bubble bursting in late 2002. In this case, internet companies were being overvalued as there was a lot of hype around them. Once people realized that some of these companies would never be able to live up to these high valuations, the stocks of these companies tanked with the NASDAQ losing 78% of its value.

More recently, the coronavirus has caused many countries around the world to impose much needed lockdown measures, causing the world economy to enter into a recession and the S&P500 to decrease in value by 31% within just two months. The price of a stock is in theory equal to the discounted value of expected future profits (Gordon & Shapiro, 1956). If this outlook unexpectedly changes for the worse, such as in the above cases, then the stock price will decrease. Thus, it is not uncommon for stock markets to suddenly change in value this drastically.

When looking at a major stock index such as the S&P500, a clear upward trend is visible This can be seen in figure 1.1 (Yahoo finance, 2020). Between 1889 and 1978, the average return per year for the S&P500 was equal to 6.98% (Mehra & Prescott, 1985). However, there are also some periods where the yearly returns are negative. These periods where the market is trending downwards are called bear markets. The opposite of this is a bull market where the market is trending upwards.

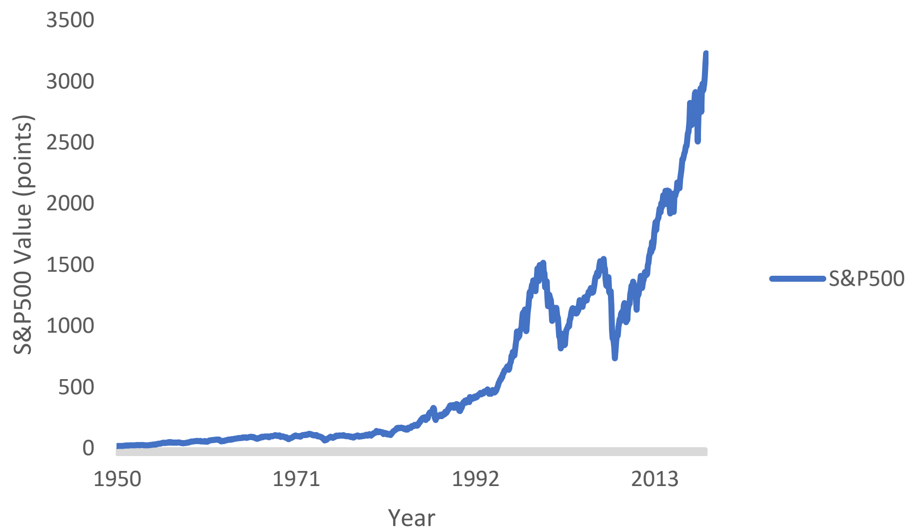

Figure 1.1 S&P500 value from 1950 till 2020

There is a whole internet forum called Wall Street Bets where people consider themselves to be in team bear or team bull. They then “bet” on the market to go up or down, sometimes even based on just the toss of a coin. Their “investing” horizon is often a few weeks or even just days. As it is close to impossible to predict where the market will be going in such a short time, a coin toss is probably just as accurate (Chen, 2009).

The antithesis of people on the internet betting on market movements is that various scholars have been developing models that try to explain differences in stock prices. One of these models is the Three Factor Model that was developed by Eugene Fama and Kenneth French in 1992. This model tries to predict the return of an individual stock based on its sensitivity to 1) a market factor 2) a size factor and 3) a value factor. A stock is subjected to systematic risk which is compensated with returns. More systematic risk is rewarded with higher returns. The above factors proxy for this risk and each company its sensitivity to these factors depends on its exposure to risk (Fama & French, 1992).

When the whole market is examined over a long period of time, these three factors are found to be significant in explaining differences in returns in the cross-section. However, the interaction effect between bear markets and the three factors is not well researched.

A possible expansion of the model by adding additional factors thus seems possible and leads to the following research question:

Does the bear market of 2008 have an effect on the sensitivity of S&P500 constituents to the three factor model compared to the bull markets surrounding it and can the model be improved by taking bear markets into account?

This research question specifically focusses on S&P500 constituents as the stocks belonging to this index are popular with both individual and institutional investors, easily tradeable and data is widely available. The bear market of 2008 is chosen as the test period as it affected most of the stock market and plenty of data is available from this period.

This thesis is academically relevant to both research into bear markets as well as research into the three factor model. The effect of bear markets on S&P500 constituents is examined, giving an insight as to how stocks react in a bear market when examined using the three factor model. Furthermore, many additional factors have been suggested, even by Fama & French themselves in 2015. This research may add an additional factor to this list.

Moreover, this research could be interesting for investors as well. If investors anticipate a bear market, then insights into differences in returns between stocks during a bear market may give them a competitive advantage in the market.

This thesis will start out with a theoretical framework where current academic literature on asset pricing, the three factor model and bear markets will be discussed. This is followed by a data section where the sample selection and variables are outlined. A methodology section explains the different regressions and adjusted R-squared technique that will be used. Then, the results section discusses the significance and sign of the regression results and the adjusted R-squared of two models is compared. Finally, the conclusion gives an overview of the results and lays out suggestions for future research.

3. Theoretical framework

Researchers have been studying asset prices for a long time. One of the fundamentals of asset pricing is that the price of any asset in a market is determined by supply and demand. This is called the general equilibrium theory and it was first published by Léon Walras (1874). If supply is larger than demand, then the price of an asset will go down and vice versa. This is also what happens on the stock market.

3.1 Capital Asset Pricing Model

The Capital Asset Pricing Model (CAPM) is a model that was developed by William Sharpe in 1964 and John Lintner in 1965, who researched it independently from one another. This model can be seen as the birth of asset pricing theory (Fama & French, 2004). It builds upon a model that was constructed by Harry Markowitz in 1959 which is commonly called the “mean variance model”. The idea behind the model is that investors try to maximize mean returns given the variance while also trying to minimize variance given the mean returns (Markowitz, 1959).

The CAPM model expands on this by adding several assumptions and several theoretical insights. The two main assumptions are that 1) unrestricted risk-free lending and borrowing exists for all investors and 2) all investors have access to the same information which they all agree on. These assumptions may not fully hold in reality but allow for the theoretical existence of the CAPM model (Fama & French, 2004).

The equation for the CAPM model is as follows:

$$E(R_i) = R_f + \left[E(R_M) - R_f\right]\beta_{iM} \ + \ \epsilon_i, i = 1, \dots , N$$

Here $E(R_i)$ is equal to the expected return on an asset i, R_f is the return on a risk-free asset, $E(R_M)$ is the expected market return, β_{iM} is asset i's specific sensitivity to the market factor and ϵ_i is the error term for asset i.

As can be seen in the formula, the CAPM models the expected return of an asset which depends on the risk free rate plus a risk premium (Guant, 2004). The basic idea behind this is that investors want to be compensated for the time value of money in the form of the risk-free rate and also require compensation for taking on extra risk dependent on the market sensitivity and risk compensation per unit of beta.

Real world tests of this model have however been inconclusive. Depending on the stock market and time period, evidence is either in favor or out of favor of the CAPM model. Lakonishok and Shapiro (1986) found that the model was not able to significantly explain differences in stock returns in the period of 1962 till 1981 for the American stock market. However, in a similar study done by Clive Guant (2004), the beta in the CAPM model did appear to be significant. This contrasting evidence shows us that the model is theoretically sound but sometimes lacks power in the real world.

There are also some anomalies in the cross-section of stock prices that cannot be explained by the CAPM model. Research has shown that adding a size factor significantly increases the predictive power. As it turns out, smaller companies earn a higher average return than their larger counterparts, even when controlling for beta (Banz, 1981). Furthermore, there is evidence that firms with a high book value to market value (B/M) earn higher average returns (Rosenberg et al, 1985) (Lakonishok et al, 1994). These two phenomena are called anomalies as they cannot be explained by the CAPM model, nor is there a solid theoretical explanation. However, it is commonly believed that these two factors are proxies for risk (Fama & French, 1992).

3.2 Three factor model

Fama and French (1992) developed a model that expanded on the CAPM model by adding a size factor as well as value factor. It is therefore often named the three factor model. This allowed them to correct for the above mentioned anomalies and more accurately predict average return of stocks in the cross section. Guant (2004) compared this three factor model with the market factor model by testing them on stock price data from the Australian stock market. He found that the three factor model yielded more significant results and obtained a higher adjusted R-squared.

The formula for the Fama and French three factor model is as follows:

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1\left(R_{Mt} - R_{ft}\right) + \beta_2 SMB_t + \beta_3 HML_t + \epsilon_{it}$$

In this formula R_{it} is equal to the return of an asset i at time t, R_{ft} is equal to the risk free rate at time t, α_{it} is the constant, R_{Mt} is the return on the market portfolio, SMB_t is equal to the size premium, HML_t is the value premium, $\beta_{1,2,3}$ are the factor coefficients and ϵ_{it} is the error term.

The factor coefficients in this model express the sensitivity of a stock towards a certain factor. For example, a company that is highly dependent on good market conditions to do business, such as a bank, will most likely have a high sensitivity towards the market factor.

3.3 Bull and bear markets

When looking at a graph of the score of a major stock index, such as the S&P500, a long-term upwards trend can clearly be seen. This upwards trend can be split into periods where the market is either trending upwards or downwards. An upwards trend is called a bull market and a downwards trend is called a bear market. A more concise definition of bull and bear markets is as follows: bull and bear markets are characterized by statistically significant differences in return that persist for some time (Gonzalez et al, 2005).

Dividing up a market in bull and bear periods is an arbitrary procedure. Fabozzi and Francis (1977) used a definition that was based on the overall market trend. This meant that even when the market was up for a certain month, if it was surrounded by months with a negative return, it would still be categorized as part of a bear market.

The point where a bull market transitions into a bear market or vice versa can be called a turning point. Pagan and Sossounov (2003) have set out some rules that help determine these turning points. A bull or bear market always starts and ends with a peak or trough.

- The window for identifying local peaks and troughs is 8 months on either side.
- The length of a bull and bear market combined is at least 16 months.
- The minimum length of either is 4 months.
- In order to ensure that extreme market movements do not go unnoticed, the minimum length of 4 months is discarded when there is a market movement of more than 20%.

If we apply this definition to the S&P 500 index, then we find that the latest bear market runs from October 2007 till March 2009. The bull market before this period started in September 2002 and the bull market after this period ended in February of 2020.

3.4 Investor sentiment

"In the worst months of the crisis, investors' return expectations and risk tolerance decrease, while their risk perceptions increase. Towards the end of the crisis, return expectations, risk tolerance, and risk perceptions recover." (Hoffmann et al, 2013) This conclusion was drawn by researchers after studying investor behavior during the financial crisis of 2008 to 2009. Still, the same paper found that investors did not always act on their decreased risk tolerance and did not significantly de-risk their portfolio.

3.5 Hypothesis development

This decreased risk tolerance may eventually lead to panic selling. In a bear market, an investor will sell as they see their stocks go down in value and want to prevent them from decreasing further. This can cause a vicious cycle where panic selling causes prices to go down, which causes more panic selling (Renshaw, 1984) Combining this knowledge with the three factor model gives us the first hypothesis:

H1: The sensitivity to the market factor increases in a bear market as stocks move with the market due to panic selling.

The size premium and value premium factors were added to correct for the over-performance of these two categories (Fama & French, 1992) This is because these two categories bring more risk and on average earn higher returns. In a bear market these companies tend to underperform instead of overperform as small companies and/or companies that have performed poorly in the past are more likely to struggle with an economic recession (Bernanke, 1981) This may increase the return disparity and lead to higher sensitivities to the size premium and value premium. Thus the second hypothesis is as follows:

H2: The sensitivity to the size premium and value premium factors will increase.

Furthermore, as all sensitivities to these factors are expected to be different during a bear market, then updating the model by adding a bear market interaction effect may increase the explanatory power of the three factor model.

H3: The explanatory power of the model can be increased by taking the bear market of the year 2008 into account.

4. Data

In order to test the hypotheses above, share price data is needed. As this research focusses on the S&P500 and the bear market of 2008, data was widely available. Collection techniques are discussed in this data section. It will also discuss portfolio formation and descriptive statistics are provided.

4.1 Sample period

The sample period runs from September 2002 till February 2019. September of 2002 was chosen as the beginning of the sample period as this marks the start of the bull market that occurred before the bear market of 2008. Data was available till February 2019 which is why it marks the end of the sample period. Data is collected on a monthly basis, as this was also done by Fama and French (1992). Similar research on the validity of the three factor model that was performed by Halliwel et al. (1999) used a sample period of 11 years and Gaunt (2004) utilized data spanning 9 years. Thus this sample containing over 16 years of data is larger than the sample used by comparable studies.

4.2 Sources

Accounting and stock price data was gathered using DataStream. DataStream collects high quality data using various sources. This data can easily be accessed and downloaded for a fee. The data is corrected for corporate events and checked on errors (DataStream, 2020).

The size premium, value premium and risk sensitivity premium are available on the personal website of Kenneth French. French updates and publicizes this data on a monthly basis. These factors are calculated by constructing portfolios on the basis of the B/M (book to market) ratio and size. The differences in return are then calculated which are the premiums. A more detailed description is available on the website. The three factors are calculated for different regions such as Europe, North America, developing countries, etc. As all S&P500 companies are American, the North American factors are the most representative. The three factors are calculated by using data on almost all stocks listed on an American stock exchange. This makes it so that the complete North American market is taken into account (French, 2020).

The database of Kenneth French also contains the risk-free rate for North America. This is equal to the United States one month treasury-bill rate (French, 2020).

4.3 Portfolio formation

As this thesis focusses on companies that are in the S&P500, only companies that are part of the index for the entire sample period are considered. This leaves 381 companies. One of these companies had missing observations and was therefore omitted from the sample.

The data will be analyzed by using a slightly adapted method that was also used by Gaunt (2004) and Halliwel et al. (1999). Before the sensitivity to the different factors is calculated, 25 different portfolios are formed. These 25 different portfolios are formed on the basis of size and B/M ratio. The goal of this is to control for characteristics (Daniel & titman, 1997) The portfolios are formed by first sorting the companies on market capitalization into quintiles which, consequently, contain 76 companies each. The overall market capitalization is calculated as the average of the monthly market capitalization over the sample period. The first quintile contains the smallest companies and the fifth contains the largest. Independently, the companies are assigned to equally sized quintiles where the first quintile contains companies with a low average B/M ratio and the fifth contains those with the highest. This average B/M ratio is calculated by dividing the book value over the market capitalization for each month and then averaging these ratios. Subsequently, the monthly B/M ratio is averaged for each company over the whole sample period.

Next, the 25 portfolios are formed where each portfolio is an intersection of two quintiles. For example, one portfolio contains companies that are in the first quintile for both categories. Another one contains companies that are in the second quintile with regards to size and the fifth quintile with regards to the B/M ratio.

4.4 Descriptive statistics

The implicit goal of this portfolio formation is “controlling unwanted interquintile variability” (Gaunt, 2004). This goal is largely achieved here, yet there are some exceptions. Gaunt experienced an overrepresentation of small companies in the high B/M quintile. As can be seen in Table 1, this is not the case. However, the reverse appears to be happening where there is an overrepresentation of large companies in the lower B/M quintile.

Table 2 shows us that size is actually reasonably well controlled for. This means that if a significant SMB (small minus big) effect is found then this should be taken seriously. The same appears to be the case for Table 4, where a significant HML (high minus low) factor should be considered as accurate.

Table 1

Number of companies

	Low B/M	2	3	4	High B/M	All
Small	8	14	19	18	17	76
2	14	16	20	14	12	76
3	17	10	17	16	16	76
4	16	14	10	18	18	76
Large	21	22	10	10	13	76
All	76	76	76	76	76	-

Table 2

Market capitalization (billion $)

	Low B/M	2	3	4	High B/M	All
Small	4.8	4.4	4.2	4.5	4.6	4.5
2	7.6	7.7	7.6	7.5	7.2	7.52
3	12.2	13.2	12.4	12.7	12.1	12.52
4	22.1	23.8	22.4	21.6	21.5	22.28
Large	98.8	90.0	127.7	84.1	83.4	96.8
All	29.1	27.82	34.86	26.08	25.76	-

Table 3

Book value (billion $)

	Low B/M	2	3	4	High B/M	All
Small	0.6	1.7	1.4	2.1	3.1	1.78
2	1.3	1.7	2.6	3.7	5.3	2.92
3	1.5	3.5	4.7	6.0	9.1	4.96
4	3.4	6.6	8.0	10.8	15.6	8.88
Large	15.4	23.2	44.4	45.2	74.5	40.54
All	4.44	7.34	12.22	13.56	21.52	-

Table 4

Book to market ratio

	Low B/M	2	3	4	High B/M	All
Small	0.16	0.28	0.40	0.56	0.80	0.44
2	0.18	0.28	0.38	0.55	0.85	0.45
3	0.15	0.28	0.41	0.55	0.83	0.44
4	0.17	0.30	0.39	0.56	0.82	0.45
Large	0.16	0.29	0.37	0.53	1.35	0.54
All	0.16	0.28	0.39	0.55	0.93	-

Lastly, a monthly value weighted return is calculated for each portfolio. This is done by first adding up all of the market capitalizations at the 1^{st} of every month for each portfolio. Then the total of the next month is divided by the total of the current month and one is subtracted, giving us the value weighted return of each portfolio for the current month. The result is 198 monthly value weighted returns for 25 portfolios. The average monthly returns per portfolio are shown in Table 5.

Table 5

Average monthly value weighted portfolio returns

	Low B/M	2	3	4	High B/M
Small	1.11%	1.04%	0.96%	1.10%	0.91%
2	0.62%	0.85%	0.86%	0.76%	0.80%
3	0.64%	0.53%	0.63%	0.94%	0.69%
4	0.90%	0.56%	0.81%	0.80%	0.70%
Large	0.41%	0.40%	0.13%	0.55%	0.65%

5. Methodology

In order to test the three hypotheses, the three factor model needs to be estimated. The first two hypotheses require a dummy variable to be created and the third hypothesis will compare the updated model with the traditional three factor model.

5.1 First and second hypothesis

First off, a dummy variable is created that takes the value 0 when the S&P500 is experiencing a bull market and is equal to one when the S&P500 is in a bear market. According to the criteria set out by Pagan and Sossounov (2003), there was a bear market from October 2007 till March 2009.

Additionally, three interaction effect variables are created. This is done by multiplying the three Fama & French factors with the bear market dummy variable. The significance of these factors will tell us whether or not the sensitivity of S&P500 companies to the three original factor loadings does significantly change in a bear market. The coefficient of these interaction factors will tell us the sign and by how much they change.

OLS regression is used as it is reasonably robust (Pesaran & Timmermann, 1995). The regression formula can be seen below:

$$RP(t) - RF(t) = a + \beta_1 MktRF(t) + \beta_2 SMB(t) + \beta_3 HML(t) + \beta_4 MktRFBear(t) + \beta_5 SMBBear(t) + \beta_6 HMLBear(t) + \varepsilon(t)$$

$RP(t)$ = portfolio return at time t

$RF(t)$ = risk-free rate at time t

a = constant

$\beta_{1,2,3,4,5,6}$ = coefficient

$MktRF(t)$ = Market risk factor at time t

$SMB(t)$ = small minus big factor at time t

$HML(t)$ = high minus low factor at time t

$\beta_4 MktRFBear(t), \beta_5 SMBBear(t), \beta_6 HMLBear(t)$ = interaction effect factors at time

$\varepsilon(t)$ = error term at time t

5.2 Third hypothesis

For the third hypothesis, a comparison between the original three factor model and the updated three factor model is made. The most concrete way to do this is by comparing the adjusted R-squared of both models for each portfolio. The adjusted R-squared will increase when an added factor improves the model more than would be expected by chance. Therefore, a higher adjusted R-squared would mean that the predictive power of the model has been improved (Miles, 2014).

6. Results

The results of the regression mentioned in the methodology section are presented in Table 6,7 and 8. Only the results of the three interaction factors are presented as the other factors are not relevant to the hypotheses. The regression results of the other variables can be found in the appendix.

6.1 Hypothesis 1

The first hypothesis stated that S&P500 constituents are expected to be more sensitive to the market factor during a bear market. If this is the case then it is expected that the market risk interaction factor will be significant and positive. As can be seen in Table 6, this factor is significant at the 5% level in only three portfolios. Furthermore, the coefficient appears to be positive in just over half of the portfolios. Based on these results, it is safe to say that this factor is not significant, nor is there any evidence that the coefficient is positive.

Therefore, the hypothesis that the sensitivity to the market factor increases in a bear market as stocks move with the market due to panic selling is rejected. A possible explanation for this is that investors do not significantly de-risk their portfolios (Hoffmann et al, 2013). Consequently, investors do not always move their investments from stocks to other assets, even though investor risk tolerance may change.

Table 6

Coefficient MktRFBear						*p* value					
	Low	2	3	4	High		Low	2	3	4	High
Small	0.112	0.147	0.019	0.281	-0.150	Small	0.53	0.39	0.89	0.11	0.29
2	0.222	-0.238	-0.037	0.236***	0.165	2	0.19	0.14	0.77	0.10	0.23
3	0.048	0.178	0.133	0.295**	0.268**	3	0.74	0.29	0.38	0.03	0.04
4	-0.095	0.081	0.141	0.318**	0.046	4	0.41	0.58	0.28	0.02	0.71
Big	-0.070	0.013	-0.111	-0.094	-0.087	Big	0.45	0.90	0.37	0.45	0.64

* 1% significance ** 5% significance *** 10% significance

6.2 Hypothesis 2

The second hypothesis stated that due to increased distress, the sensitivity to the HML and SMB factors will increase during a bear market**.** The regression results should then show that the SMB and HML interaction factors are both significant and positive.

The results in table 7 and table 7 show that both factors are significant at the 5% level in about half of the portfolios. Additionally, the significant portfolios all have positive coefficients for the HML factor and 24 out of the 25 portfolios have a positive coefficient for the SMB factor. Combined with the significant results of half of the portfolios, one may conclude that the sensitivity of S&P500 constituents increased during the bear market of 2008.

Perhaps, the explanation lies in the justification that was given by Fama and French for including the size and value factors. They argued that smaller companies are more vulnerable than larger companies and a high B/M ratio is a sign of relative distress (Fama & French, 1996). Moreover, a bear market will often go hand in hand with a recession, which causes small businesses and vulnerable companies to come under even more distress (Cowling et al, 2014). Therefore, the effects of these factors are magnified during a recession, causing the sensitivity of companies to these factors to increase.

Table 7

Coefficient SMBBear *p* value

	Low	2	3	4	High		Low	2	3	4	High
Small	0.293	0.421	1.016*	0.605	1.018*	Small	0.54	0.36	0.01	0.20	0.01
2	-0.195	1.532*	0.577	1.118*	0.365	2	0.67	0.00	0.08	0.00	0.32
3	0.512	0.925**	1.094*	0.913*	0.433	3	0.18	0.04	0.01	0.01	0.22
4	1.274*	0.221	0.677***	0.075	1.272*	4	0.00	0.57	0.06	0.83	0.00
Big	0.903*	0.486***	0.635***	0.643***	1.277*	Big	0.00	0.08	0.06	0.06	0.01

** 1% significance ** 5% significance *** 10% significance*

Table 8

Coefficient HMLBear						*p* value					
	Low	2	3	4	High		Low	2	3	4	High
Small	0.968*	0.487	0.571**	0.359	0.94*	Small	0.00	0.12	0.02	0.26	0.00
2	0.642**	0.665**	0.249	0.404	0.33	2	0.04	0.03	0.27	0.12	0.18
3	0.849*	0.548	-0.276	-0.031	0.15	3	0.00	0.07	0.32	0.90	0.52
4	0.640*	-0.081	-0.248	-0.038	0.14	4	0.00	0.76	0.30	0.88	0.52
Big	0.519*	0.392**	0.724*	0.579*	2.02*	Big	0.00	0.04	0.00	0.01	0.00

* 1% significance ** 5% significance *** 10% significance

6.3 Hypothesis 3

Hypothesis 3 entailed that if bear markets were taken into account in the three factor model, then the explanatory power of the model could be improved. This would be the case if the adjusted r-squared was higher for the updated model. The difference between the adjusted r-squared of the two models is shown in Table 9. The adjusted R-squared of both models for each of the 25 portfolios can be found in the appendix.

There is just one difference that is not positive out of 25. Thus, it is safe to say that adding the interaction effect factors to the regression does indeed improve the model. It seems to be only a small improvement in some cases, yet the smallest trading advantages can make a big difference.

Table 9

Adjusted R-squared new model minus old model

	Low B/M	2	3	4	High B/M
Small	0.013	0.006	0.014	0.009	0.023
2	0.006	0.017	0.002	0.024	0.006
3	0.015	0.012	0.016	0.030	0.012
4	0.036	-0.002	0.011	0.008	0.019
Large	0.019	0.006	0.013	0.008	0.054

7. Conclusion

The aim of this thesis was to explore the answer to the following question: does the bear market of 2008 have an effect on the sensitivity of S&P500 constituents to the three factor model compared to the bull markets surrounding it and can the model be improved by taking bear markets into account?

7.1 Main results

The first part of the question can be answered with a definite yes, however sensitivities did not necessarily behave as expected. The sensitivity to the market risk factor appeared to not change significantly. This is unexpected as the increased risk during a bear market may cause the overall market direction to become more important.

The sensitivities to the other two factors did change significantly and appeared to increase. This is likely a result of the existing return differences being magnified. This is the consequence of increased risk and uncertainty during a recession that is especially felt by smaller and value companies.

The fact that sensitivities do appear to change means that the model can be improved by taking these into account by incorporating interaction effect factors. An increase in adjusted R-squared showed that this is indeed the case.

7.2 Limitations and recommendations for future research

This thesis focused on S&P500 companies and the bear market of 2008. This is an advantage as these stocks are popular and the recent data may be more relevant . However, a drawback is that it does not allow general statements about the effect of bear markets on stocks to be made. To do this, more bear markets and stocks should be used in the sample. Perhaps, effects of different bear markets can be examined.

Furthermore, predicting stock returns before they occur is extremely difficult. There is absolutely no guarantee that the results that were found with the sample used in this thesis will also occur in the future. Therefore, the relevance for this research in the future is anything but guaranteed.

Additionally, predicting bear markets is possible (Chen, 2009) but not always accurate. It can even be difficult to identify a bear market as soon as it begins or identify when it is ending. This makes the model not that suitable for predicting future differences of stock returns in the cross-section. It is better suited at giving insights into which sensitivities change and compare different bear markets.

8. References

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9. Appendix

Table 10

Coefficient MktRF						*p* value				
	Low	2	3	4	High		Low	2	3	4	High
Small	0.844*	0.785*	1.062*	1.010*	0.849*	Small	0	0	0	0	0
2	0.805*	1.133*	0.902*	1.071*	0.766*	2	0	0	0	0	0
3	0.761*	1.141*	1.089*	0.816*	0.862*	3	0	0	0	0	0
4	0.731*	1.127*	0.930*	0.849*	1.115*	4	0	0	0	0	0
Big	0.814*	0.844*	0.925*	0.911*	1.248*	Big	0	0	0	0	0

** 1% significance ** 5% significance *** 10% significance*

Table 11

Coefficient SMB						*p* value					
	Low	2	3	4	High		Low	2	3	4	High
Small	0.618*	0.070	0.138***	0.753*	0.267*	Small	0.00	0.45	0.06	0.00	0.00
2	0.662*	0.078	0.009	0.064	-0.096	2	0.00	0.38	0.89	0.41	0.20
3	0.494*	0.276*	0.291*	0.006	-0.134***	3	0.00	0.00	0.00	0.93	0.06
4	-0.054	0.310*	-0.317*	0.187*	-0.054	4	0.38	0.00	0.00	0.01	0.42
Big	-0.342*	-0.297*	-0.219*	-0.238*	-0.093	Big	0.00	0.00	0.00	0.00	0.35

** 1% significance ** 5% significance *** 10% significance*

Table 11

Coefficient HML *p* value

	Low	2	3	4	High		Low	2	3	4	High
Small	-0.276*	-0.008	0.355*	0.015	0.371*	Small	0.00	0.92	0.00	0.86	0.00
2	-0.531*	-0.043	0.345*	0.536*	0.677*	2	0.00	0.58	0.00	0.00	0.00
3	-0.249*	-0.281*	0.065	0.347*	0.469*	3	0.00	0.00	0.37	0.00	0.00
4	0.124**	-0.046	0.544*	0.106***	0.518*	4	0.02	0.51	0.00	0.10	0.00
Big	-0.244*	-0.152*	-0.042	0.365*	0.387*	Big	0.00	0.00	0.47	0.00	0.00

** 1% significance ** 5% significance *** 10% significance*

Table 12

Constant *p* value

	Low	2	3	4	High		Low	2	3	4	High
Small	0.68*	0.62*	0.28	0.50***	0.28	Small	0.01	0.02	0.17	0.07	0.20
2	0.28	0.22	0.23	0.08	0.21	2	0.28	0.38	0.21	0.73	0.33
3	0.24	0.02	-0.03	0.42**	0.13	3	0.28	0.93	0.90	0.05	0.52
4	0.45*	-0.10	0.17	0.30	-0.04	4	0.01	0.66	0.39	0.14	0.83
Big	0.07	0.02	-0.34***	-0.04	-0.01	Big	0.63	0.92	0.07	0.83	0.98

** 1% significance ** 5% significance *** 10% significance*

Table 13

Adjusted R-squared three factor model

	Low B/M	2	3	4	High B/M
Small	0.623	0.489	0.726	0.694	0.617
2	0.680	0.659	0.682	0.712	0.627
3	0.659	0.711	0.705	0.615	0.652
4	0.603	0.737	0.674	0.656	0.764
Large	0.737	0.721	0.666	0.661	0.625

Table 14

Adjusted R-squared new model

	Low B/M	2	3	4	High B/M
Small	0.636	0.495	0.740	0.703	0.640
2	0.686	0.676	0.684	0.736	0.633
3	0.674	0.723	0.721	0.644	0.664
4	0.639	0.735	0.684	0.664	0.783
Large	0.756	0.728	0.679	0.670	0.679