MOMENTUM IN FINANCIAL CRISES

AN EVALUATION OF THE MOMENTUM INVESTING STRATEGY DURING DIFFERENT TIME PERIODS

LOVISA BERGLUND
FILIP FRÖJD
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Momentum in Financial Crises: An Evaluation of the Momentum Investing Strategy During Different Time Periods

Abstract:

This thesis investigates the momentum investing strategy during the years 1927 to 2020. The research focuses on both longer time periods and smaller periods of time, more specifically financial crises. This thesis has obtained inspiration from previous research in the area by Jegadeesh and Titman (1993) as well as Daniel and Moskowitz (2016). The methodology follows these two articles with an extension regarding both time period examined as well as test used over different periods. The main question of the thesis is as follows: Does the momentum strategy hold for financial crises in the American stock market during the last century, including the recent Covid crisis? The sub question of this thesis is: Does the momentum strategy hold for the last decade and century in the American stock market? The results point in favour of rejecting the null hypothesis and the study concludes that momentum investing strategy is successful over longer periods but fails in financial crises.

Keywords:

Big data, Momentum, Finance, Financial Crises, Investment Strategy

Authors:

Lovisa Berglund (24436)
Filip Fröjd (24428)

Tutors:

Olga Obizhaeva, Assisting Professor, Department of Finance

Examiner:

Adrien d'Avernas, Assistant Professor, Department of Finance

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Stockholm School of Economics

1. Introduction

During the last few decades, the momentum investing strategy has been developed. When one uses the momentum strategy in investing decisions, one takes a long position of past winners and a short position of past losers. This can be simulated using a winners-minus-losers framework (Jegadeesh and Titman, 1993). These actions form the stock portfolio which is constantly updated with predetermined intervals. For example, Daniel and Moskowitz (2016) use yearly returns as the basis for the portfolios which they update monthly.

Research has found that this strategy is very successful during long time-series (e.g. Jegadeesh & Titman (1993)). However, more recent research has made some important findings (e.g. Daniel & Moskowitz (2013); Asness et al. (2012); Robert Novy-Marx (2011) etc.). According to Daniel and Moskowitz (2016), the strategy is quite weak during financial crises and it returns almost the opposite result during these time periods. This thesis will further elaborate on this statement by expanding the time-serie to contain the most recent decade, including the Covid year as well as elaborating with different lengths of the holding periods as well as different portfolio formations. This will create a distinction compared to previous research since the ones the authors of this thesis are aware of only lead up to 2013 (Daniel and Moskowitz, 2016) and thus excludes the Covid crisis. Moreover, this thesis will follow the previously mentioned research and focus on the American stock market. In order to perform this research, large quantities of data of past stock prices will be required. The American stock market consists of many thousands of companies and would thus satisfy this requirement. To specify, this thesis limits the data to stocks traded at New York Stock Exchange (henceforth NYSE) and American Stock Exchange (henceforth Amex), in accordance with Jegadeesh and Titman's methodology.

During the last century, the market has experienced a few financial crises. One of them is the Great Depression which took place during the time period of 1929 to 1939 which affected many countries and markets (NE, 2021). The IT crash in the beginning of the 2000 is another example of a crisis that has recently occurred which affected the markets around the world (Samuelsson, 2021). Another financial crisis that profoundly impacted the global market was the 2008 financial crisis (NE, 2021). This pattern of recurring crises correlates with the phenomenon that financial crises occur during cycles in the market (Aktiespararen, 2021). Therefore, the economy will most likely experience financial crises in the future, which makes this research valuable since it brings new knowledge on how the momentum strategy reacts during financial crises.

1.1. Problematisation

When the momentum investing strategy was first discovered by Jegadeesh and Titman (1993) the strategy was simpler than it is today. The concept was, as already described, to long winners and short losers. However, when Daniel and Moskowitz (2016) started investigating this strategy during the financial crises, they discovered that the strategy did not hold during these periods of crises. The conclusion of this research was that when in a bear market, the past winners decline more than the past losers do.

Consequently, the betas of past winners are higher than the betas of past losers. Therefore, the past winners become losers, since they experience a more negative return than the previous losers with lower beta. When the crisis recovers, the new losers will be the companies with the high beta and the new winners will be the companies with the low beta. In the following holding period, the new losers will follow the positive return on the market to a greater extent than the new winners. Therefore, in bear markets, the momentum strategy is unfavourable. This thesis aims to explain how the momentum investing strategy was affected by recent financial crises including the Covid period of 2020. Moreover, the thesis will also examine if the strategy as a whole hold for the last decade and century.

1.2. Research Question and Purpose

To the authors knowledge, the performance of the momentum investing strategy has not yet been tested during the Covid year. Through replicating Jegadeesh and Titman (1993) and extending the data set through the year 2020, this thesis pursues to complement the existing research and bring new knowledge to the existing field. Hence, the purpose of this thesis is to assess how the momentum strategy performs during financial crises and during longer periods from 1927 up to the end of 2020. The following questions is targeted by the thesis:

Research question: Does the momentum strategy hold for financial crises in the American stock market during the last century, including the recent Covid crisis?

Sub Question: Does the momentum strategy hold for the last decade and century in the American stock market?

1.2.1. Knowledge Contribution and Aim

The momentum strategy performance has been researched multiple times. Some of the researchers have found that the momentum strategy holds for different market sizes and in a market state with low risk (e.g. Jegadeesh & Titman, 1993; Asness et al. (2012); Robert Novy-Marx (2011)). Others have found that the momentum strategy holds in all states except panic states such as stock market crashes or recessions (e.g Daniel & Moskowitz, 2016; Maheshwari & Dhankar (2017)). This research goes as far as to the year 2013, but not further than that and they do not include the Covid year. Furthermore, the research conducted on financial crises does not consider different lengths of the observation and holding periods. This thesis therefore aims to fill this gap in the research and thus aim to conduct a more dynamic study of the momentum strategy during crises.

2. Literature Review

2.1. Introduction

The following section features definitions that are relevant for further comprehension of the thesis. Thereafter, the prominent theoretical frameworks used will be presented, followed by a literary review of the previous research conducted in the area.

2.2. Definitions

This section contributes with definitions of Momentum Investing Strategy and Financial Crises.

2.2.1. Momentum Investing Strategy

This thesis defines momentum investing as investing according to past performance of stocks. When implementing the momentum investing strategy, a long position in past winners and a short position in past losers will underlie the total return of one's portfolio (CFI, 2021).

2.2.2. Financial Crises

Financial crises can take many different shapes and are characterised by intricate outcomes. Normally, asset prices change to a large degree during time periods of financial crises. This is accompanied by changing trading volumes as well as balance sheet problems for both households and companies. This development is often accompanied by an intervention from the government with large support systems. The root of the financial crisis can be bank runs, financial markets experiencing stress and asset firesales to a greater extent. Once the economy experiences a financial crisis, the economic activity and costs are affected. Furthermore, a financial crisis is often accompanied by a recession that usually extends to six quarters, whilst regular recession only last for four quarters (IMF, 2013). This thesis will focus on the following financial crises: Great Depression during 1929 to 1939 (NE, 2021), The IT crash in the beginning of the 2000 (Samuelsson, 2021), The 2008 financial crisis (NE, 2021), The Covid crisis during 2020 (Reinhart, 2021). Apart from these financial crises, Black Monday during 2011 will also be mentioned (The Guardian, 2021).

2.3. Theoretical Framework

2.3.1. Winners-Minus-Losers (WML)

In order to evaluate the momentum investing strategy, the thesis has chosen to look at winner-minus-loser (henceforth WML) portfolios, with the intention to reflect the position one takes when applying momentum investing. Thus, a long position is taken in the highest portfolio and short the lowest portfolio (French, 2021). This is the concept of winners minus losers and what momentum investing is all about. Individual stock

performances are widely different to one another. Some achieve really high returns, while others achieve really low. By analysing the past years performance for all stocks in the sample one tries to predict the future outcome of the stocks. By following momentum investing strategy the investor believes that the stocks with worst performance will continue to perform badly and the stocks with high performance will continue to perform well (IMF, 1997). This leads up to the framework of investing long in winners and short in losers.

The WML structure can take many different shapes, as long as the investor holds a long position in past winners and a short position in past losers. This thesis will split the market into ten decile portfolios according to the past performance of the stock. This means that the WML portfolio will represent the winning portfolio, consisting of the top 10% of companies according to past return, minus the losing portfolio, the bottom 10% of companies.

2.3.2. Simple one factor model (CAPM)

A simple one factor model for the return is the CAPM formula. The model is as follows:

$$r = r_f + \beta * E(r_{mkt\ excess})$$

This model states that a specific return can be calculated using the risk-free rate of the sample and the coefficient times the market excess return. The coefficient in this model is the beta, otherwise known as a measurement of risk (Harrington, 1983). A beta around one means that the stock return moves in accordance to the market. Higher returns lead to larger movements, whereas negative betas lead to opposite movements compared to the stock market. Thus, a lower beta indicates lower risk. This model follows the structure of the well-renowned capital asset pricing model, CAPM (Fama & French, 2004). The model is used in order to estimate a portfolio return. In this thesis the unknown variable is the beta of the momentum portfolio, which will be calculated using a linear regression.

2.4. Literature Survey

This section includes a review of the foregoing research associated with the thesis. This research is connected with comparisons of financial performance over different market states as well as with momentum strategy.

2.4.1. Comparison of Financial Performance Over Different Market States

The article *Momentum Crashes*" was published in 2016 by Daniel and Moskowitz. The article argues that there are faults in the momentum strategy. The momentum strategy is to go long in past winners and short past losers. However, for a crisis that leads to a large drop in asset prices, the authors found that the following rebound period does not follow the momentum strategy. Instead, past losers, who now obtain a high beta, outperforms past winners, with a low beta, which makes it very costly to trade in accordance with the momentum strategy. Therefore, it is difficult to use the betas as a parameter for selecting assets during crashes, according to the authors.

Moreover, other researchers have studied the same perspective in different markets. One example is the article *"The Effect of Global Crises on Momentum Profitability: Evidence from the Indian Stock Market"* by Maheshwari and Dhankar in 2017. This article studies how well momentum strategies perform in the Indian stock market during the recent years, with a focus on the 2008 financial crisis. Different formation and holding periods are tested and the findings indicate that momentum performs high returns pre- and post-crisis, but negative returns during the crisis. The results prove that momentum is an unfavourable investment strategy to use during financial crises, indicating non-stability of the strategy.

2.4.2. Comparison of Financial Performance with Momentum Strategy

The research article *"Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency"* was published by Jegadeesh and Titman in 1993. The article argues that one idea within trading is that stocks move excessively and that investors are oversensitive to information. Jegadeesh and Titman therefore declared that a wise strategy would be to sell past winners and buy past losers. This theory is visible when an investor holds the asset for 3 to 5 years and also uses data from the past 3 to 5 years. What the authors found interesting is that when looking at a shorter time span of data the opposite seems beneficial. When the authors examined data from 3 to 12 months in the past and held the asset in the portfolio for 3 to 12 months, the most successful strategy, according to the authors, would be to buy past winners and sell past losers. This is the momentum strategy, which is an important finding in the research of trading strategies and strategies of increasing wealth.

The authors also found that stock prices either overreact or underreact to information, then trading strategies that select stocks based on their past returns will be profitable. The research evaluates 16 strategies that involve 1 to 4 quarters of holding time and 1-4 quarters of past data that decides which assets are winners and losers. Jegadeesh and Titman conduct tests where they skip a week to avoid bid-ask spread as well as constructing the holding period directly after the end of the observation period. The result shows that trading based on data of the past 6 months and holding the assets for 6 months gives an excess return of 12% per annum. One interpretation of the results which their study concludes is that transactions by investors who buy past winners and sell past losers move prices away from their long-run values temporarily and thereby cause prices to overreact. An alternate interpretation is that it is possible that the market underreacts to information about the short-term prospects of firms but overreacts to information about their long-term prospects, according to Jegadeesh and Titman (1993).

Moreover, the research paper *"Value and Momentum Everywhere"* by Asness et al. (2012) aims to structorise the findings of consistent momentum and value in all asset classes. Compared to passive exposures to asset classes, Asness et al. argues that the premium of momentum and value across different asset classes are more positively correlated. Although, they are negatively correlated within and across asset classes. When attempting to explain the reasons for these findings, the authors propose that liquidity risk in global funding can be discovered when looking into momentum and value at the same time across the market.

Furthermore, in 2011 Robert Novy-Marx published the research article *"Is momentum really momentum"*. The article discusses how momentum trading strategies based on intermediate past performance generate larger, more significant returns than those based on recent past performance. Furthermore, Novy-Marx argues that the former strategy has a significant alpha relative to the Fama-French four-factor model, while the strategies based on recent past performance do not have significant alphas. Strategies based on intermediate past performance have performed consistently well. Meanwhile, the author concludes that strategies based on recent past results have performed well during the 50s and 60s, although not so well during the last 40 years. The Sharpe ratios of the strategies based on intermediate horizon past performance are more than twice as large as the Sharpe ratios of the strategies based on recent past performance. According to the author, the strategies based on recent past performance never generate significant abnormal returns relative to the strategies based on intermediate horizon past performance. Novy-Marx theory suggests that past performance at intermediate horizons contributes more to the profitability of momentum strategies than past performance at recent horizons. Momentum does not accurately describe the returns to buying winners and selling losers. On average, recent winners that were intermediate horizon losers significantly under-perform recent losers that were intermediate horizon winners.

2.5. Conclusion

In conclusion, previous research displays different aspects of the momentum strategy. Jegadeesh and Titman (1993) proves that by taking a long position in past winners and a short position in past losers, the investor can generate positive return. With their research, they laid out the foundation for momentum strategy. Other researchers have continued on their trail and found results that speak for the use of momentum strategy for the investor. Asness et al. (2012) found that the use of momentum investing strategy creates a value premium compared to passive exposures. Furthermore, Novy-Marx (2011) argued for the result of momentum strategy using intermediate past returns instead of recent past returns. However, there are some researchers that have come to the conclusion that there are situations when the momentum strategy is not to be preferred. One of these studies was performed by Daniel and Moskowitz (2016). They argued that momentum strategy does not hold during financial crises, that instead of generating a positive return the strategy generates a negative return.

3. Research Design

3.1. Problem and Research Question

It has previously been shown that momentum strategy is a good tool for investing when the market is reliable. However, when there is a crisis, the strategy tends to give negative value. This research paper will therefore replicate parts of the methodology for Daniel and Moskowitz (2016) with an extension for the Covid crisis period to see if these results are applicable in this case. The methodology is mainly going to be the same as Jegadeesh and Titman (1993) regarding the formation and evaluation of portfolio performance. However, Daniel and Moskowitz (2016) have contributed with certain influences, such as the momentum strategy's performance during time periods of crises. This research will seek to find if usage of momentum strategy results in negative value during the Covid crisis in the American market.

Research Question: Does the momentum Ssrategy hold for financial crises in the American stock market during the last century, including the recent Covid crisis?

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3.2. Scientific Perspective

Fundamentally, the difference between a qualitative and quantitative method is characterised by non-numerical and numerical datasets. To understand and study a specific occurrence, the quantitative method generalises the analysis of the data through the use of numerical or statistical analysis (Babbie, 2010). Furthermore, quantitative methods take base in facts, which makes it possible to describe an independent reality as presently comprehended (Slevitch, 2011). Contrarily, the qualitative method is explanatory, emphasising the significance of a socially manufactured form of reality. Moreover, both methods take the individual's perspective into consideration, even though qualitative studies attempt to get near this perspective due to the interviews and observations they undertake (Silverman, 2005).

This thesis is conducted through a quantitative analysis. The nature of the questions aimed to be answered will best be studied through a quantitative analysis since different sets of numbers will be analysed. The numbers analysed will show whether the momentum investment strategy is favourable or not during the time series chosen.

Furthermore, this thesis conducts hypothesis testing through backtesting. The theory of backtesting tests the accuracy of a strategy by using historical data. Through backtesting, a comparison between different strategies can be made as well as a test for the vitality of a strategy, in order to know which strategy to use and if a certain strategy should be altered. Thus, backtesting allows testing of strategies without risking capital. A common measurement which the backtesting model uses is return (CFI, 2021), which this thesis will utilise in its methodology.

3.3. Model and Hypothesis Testing

3.3.1. Buy-Sell Table

The buy-sell table has been constructed in the same way as Jegadeesh and Titman's article (1993). It consists of sell portfolios and buy portfolios that, put together, create the buy-sell portfolio. The sell portfolio is the portfolio with the lowest past return, whereas the buy portfolio consists of the companies with the highest past return. The portfolios are then tested with a t-test presented beneath the return of the portfolio. The table consists of 16 different buy-sell portfolios with formation and holding periods between 3 to 12 months. The table is used for all time periods that the thesis examines. If the t-test is lower than -1.96 or greater than 1.96, a significance level of 5% is reached and the null hypothesis can be rejected.

3.3.2. WML

Another method this thesis will use to test the performance of different decile portfolios is the WML portfolio. This portfolio consists of a long position in the stocks with the highest past returns and a short position in the stocks with the worst past returns. In other words, this portfolio reflects the position taken when implementing the momentum strategy. The thesis will include the 15 worst WML portfolio returns when the formation and holding periods are both 6 months. The reasoning for choosing a 6 month formation and holding period is that it is a model which is in accordance with Jegadeesh and Titman's methodology that sums up to one year's activity. For the purpose of consistency, the same formation and holding period will be used for all of the tests that are not the buy-sell table, namely the 15 worst WML portfolios, the cumulative graphs and the OLS regression. The dates in which these 15 worst WML returns existed will thereafter be assessed in order to decide if it is during a period of financial crisis or not. This measure cannot on its own decide whether or not a period is considered as a financial crisis. However, in combination with data regarding which periods are to be considered as a financial crisis, this method can strengthen the beliefs that momentum strategy does not hold during the periods of financial distress if the worst WML returns fall inside these periods.

3.3.3. Cumulative Graphs

The monthly return can be used to compute a cumulative return of the portfolio for a number of years forward in the future. This thesis will use a cumulative graph to inspect longer time series and see where the level of the winners and the losers portfolio are in accordance with each other during the entire time period. The reasoning behind this is that if the investor invests one dollar at the beginning of the time period, the graph will show what this dollar will have yielded in either portfolio at a specific time during the time period. Thus, if the winner portfolio is above the loser portfolio, the momentum investing strategy is successful for the period and vice versa. The graph also visualises the differences in level between the two portfolios.

3.3.4. Ordinary Least Squares Regression

The Ordinary Least Squares Regression (henceforth OLS regression) will be applied in this thesis. It will be used when testing the performance of the different decile portfolios as well as the WML portfolio. The OLS regression minimises the sum of the squared distance from observations to a line that is fitted to the data, by adjusting the alpha and beta coefficients to the line. If the results vary a lot from each other, the R2 will be higher. Therefore, the line will be less fitted, and the results predicted by the OLS will be less precise. On average the line will still approximate the outcome, but individual observations may be more inaccurate. In order to apply this method, the following assumptions must be made (Brooks, 2021):

1. The model must consist of dependent and independent variables that have a linear relation, thus making the model linear.
2. X-values are not dependent on error terms since they are non-stochastic.
3. Error terms have constant variances, due to their homoscedasticity.
4. Error terms do not correlate with each other.
5. Error terms follow a normal distribution.

3.3.5. Hypothesis Testing

This section will present the hypotheses. They will be tested using a simple one factor model of linear regression, cumulative graphs, a 15 worst WML portfolio as well as buy-sell portfolio statistics. The null hypothesis will be rejected if a significance level of 5% is reached, meaning an alpha of 0.05. The tests that will be used to evaluate the significance are a t-test and the p-value. To satisfy the chosen significance level, the t-statistic needs to be smaller than or equal to -1.96 or larger than or equal to 1.96. Furthermore, the p-value must be smaller than or equal to 0.05.

3.3.5.1. Hypothesis (1)

The main question of this thesis is the following: Does the momentum strategy hold for financial crises in the American stock market during the last century, including the recent Covid crisis?

H0: The use of momentum investing strategy gives a positive return during the financial crises.

H1: The use of momentum investing strategy does not give a positive return during the financial crises.

In case the null hypothesis remains unrejected, the periods of financial crises do not influence the momentum strategy results. If, however, the null hypothesis can be rejected, the periods of financial crises do influence the momentum strategy results.

3.3.5.2. Hypothesis (2)

The following two hypotheses answers the sub question of this thesis: Does the momentum strategy hold for the last decade and century in the American stock market?

H0: The momentum investing strategy does not give a positive return during the last century.

H1: The momentum investing strategy gives a positive return during the last century.

In case the null hypothesis remains unrejected, the momentum investing strategy cannot be shown to return value over the last century. If, however, the null hypothesis can be rejected, the momentum investing strategy can be shown to return value over the last century.

3.3.5.3. Hypothesis (3)

H0: The momentum investing strategy does not give a positive return during the last decade.

H1: The momentum investing strategy gives a positive return during the last decade.

In case the null hypothesis remains unrejected, the momentum investing strategy cannot be shown to return value over the last decade. If, however, the null hypothesis can be rejected, the momentum investing strategy can be shown to return value over the last decade.

3.4. Research Ethical Reflection

This thesis has considered the ethical aspects of the research process. The ethical aspect when conducting research is crucial, with one important factor being the privacy of participants. Moreover, it is of high significance that the study is reliable, with a high quality and moral standards. The information in the study, collected data and results should all be displayed objectively and in its entirety. Furthermore, the public should have easy access to the information (Vetenskapsrådet, 2021). This research is undertaken morally and ethically, with consideration to the fair treatment of the society, the individual and other parties involved. Moreover, the research process treats its collected data without misrepresentation and by keeping it authentical. Thus, it ensures that the results presented will not be misleading.

Concerning the subject at hand, one should also discuss other ethical aspects that are associated with the thesis. Firstly, one should consider whether maximal return is needed and how this could influence the market. If all actors on the market would receive maximal return and thus only invest in a few predetermined choices, the market would fail. Therefore, the information asymmetries and other market deficiencies are there to distort the illusion of a set investment and make people take different choices when investing that keeps more companies afloat. Thus, every investor does not invest in the same few stocks. Secondly, the companies' operations are not considered in this thesis methodology. The thesis includes all companies on the stock market without regards to their ethical work processes or lack thereof. Therefore, it might not be encouraged to act in the same way this research is produced given the ethical regulations one has on one's own investments.

4. Data

4.1. Chosen Stock Markets

The chosen market is a sample of the American stock market, since the entire population of observations would be too heavy to compute. Furthermore, the research experiences limitations in time and resources. However, since the sample consists of approximately 50,000 companies it is possible to draw conclusions from the sample. Daniel and Moskowitz's (2016) dataset holds 83,000 companies, including all stocks traded on NYSE, Amex and National Association of Securities Dealers Automated Quotation (henceforth Nasdaq). This thesis has chosen to focus on only NYSE and Amex in accordance with Jegadeesh and Titman (1993). Therefore, the dataset will be somewhat smaller than Daniel and Moskowitz, but larger than Jegadeesh and Titman due to the prolonged time period.

The American market is the market that best represents the global economy, since all industries are included, and a wide variety of companies exist. Existing research of momentum during financial crises is conducted on this market, although no research has yet covered the most previous decade. This is the gap that this thesis will aim to cover and therefore it would be favourable to use the same market as the existing research has used before.

The exchanges chosen are Amex and NYSE. They are the largest markets and therefore the ones that will best contribute to this research. Smaller markets may consist of companies that do not give a fair picture of the global economy, since the thesis uses equally weighted portfolios. Therefore, the small size of the companies may distort the fair picture of the global trade that the thesis is trying to uphold. Another problem with smaller stock markets is that the strategy requires a lot of trade. This requirement would not be fulfilled by smaller companies, since they trade too small volumes for this strategy to be successful.

4.2. Time Windows

Daniel and Moskowitz (2016) research on momentum crashes is conducted with a time window spanning between 1927 to 2013. Jegadeesh and Titman (1993) focused on the time period of 1965 to 1989. Therefore, the time window will span from 1927 to 2020, and include a longer time frame than the two previously named research papers. Thus, this thesis will replicate the research previously made, but add the last decade and, most importantly, the Covid year. The reason for choosing this time period is because it effectively frames the Covid crises and the aftereffects the world has been able to see thus far. However, the century will be split into three parts, which will be the following: 1927 to 1950, 1950 to 1985 and 1985 to 2020. The reason for this is that the code that processes the data is not able to handle the entire century without terminating the running code. The period for choosing winners and losers will be ranging from 3 to 12 months with a holding period of 3 to 12 months, equal to Jegadeesh and Titman's (1993) methodology. Therefore, we test different observation and holding periods and

investigate whether the momentum strategy provides the desired return for the investor during different time frames for the investments.

However, the time period before 1950 contains a lot of zigzag price changes (Kyle et al., 2017). Uncertainties remain regarding if this is an error that should be eliminated or actual prices that need to remain in the sample. According to Fischer (1963), the creation of the database, the Center for Research in Security Prices (henceforth CRSP), involved a magnitude of data cleaning. The data gathered from the exchanges may still contain errors in the form of faulty data conversion between paper books and electronic databases, differences in split and dividend adjustments, ticker inconsistency, error accounts registering trades that are cancelled within a short time period and so on. Therefore, when evaluating the results before the 1950s, the zigzag price changes are to be taken into account.

4.3. Selection of Stocks

The selection of stocks is based on the method used in Jegadeesh and Titman (1993). The stocks included in the sample should have an existing share price and an existing number of shares outstanding. They are from either NYSE or Amex and they have a sharecode of 11 or 10. Furthermore, the stocks need to have at least 2 years of data in order to calculate the yearly returns. Moreover, all prices are closing prices. CRSP reports closing prices and it is also the data Daniel and Moskowitz (2016) as well as Jegadeesh and Titman (1993) have used. Additionally, all stocks with a price below 5 dollars are deleted in accordance with standard procedure for penny stocks. Stocks trading below five dollars are more volatile and their movement unordinary.

4.4. Decile portfolios

The entire sample of company returns will be divided into ten different portfolios as previously explained (See section 2.3.1. Winner Minus Loser (WML)). These portfolios will then be updated once every month. The reason for this is to make sure that the portfolios constantly represent the current winners and losers on all levels. The program should consist of ten portfolios during the entire time period, and the ten portfolios will each represent the different decile of company returns. This enables further investigation of the top and bottom parts of the market over a longer period of time.

The companies are separated into a portfolio based on their performance during the last year. The performance is measured like the following: the observation period consists of 3, 6, 9 or 12 months. The number used as return in the calculation is the equally weighted return during the following time period which can be 3, 6, 9 or 12 months. Appendix 1 shows this on a portfolio with a 6 month time frame. All these returns are then summed up and divided by the total number of companies within that portfolio, which gives us the mean of the specific portfolio at that specific date. By replicating this method for all companies every date from 1927 to 2020 a list of means is created for every portfolio that can be multiplicated to extract the cumulative returns for every portfolio during the time in question.

The data will provide us with one portfolio of past winners, which are stocks that have excelled during the time period before the start and thus are in the top 10 % of the market's past returns. This portfolio will then be matched with a portfolio of past losers, namely the stocks that have performed poorly in the time period before the crisis and are in the bottom 10 % of the market's past returns. These two portfolios will then act as matched pairs, meaning that a comparison will take place between the groups (See section 2.3.1. Winner Minus Loser (WML)).

4.5. Risk-Free Rate, the Market Return

The risk-free rate used in this paper is the one-month treasury bill. The risk-free rate is collected from Ken French's data library. The paper is conducting research in American stocks, which is the reason why the one-month treasury bill is a good choice for a risk-free rate. Further, the American economy is one of the world's largest economies and should therefore be a suitable indicator of the risk-free rate in the world.

The market return is collected from CRSP. It is represented through the value-weighted return (including distribution) of all the American stocks listed on CRSP. All the listed firms in CRSP give us an acceptable market return to use in the research since CRSP includes more companies than most other databases.

4.6. Data collection

To conduct this thesis, data has been gathered for the stocks from the CRSP database, since they have a database that provides the stock markets required for the replication. CRSP compiles data from NYSE and Amex from December 1925 to December 2020. Since this thesis requires data from 1927 to 2020 from NYSE and Amex stock markets, CRSP's data can satisfy these demands.

The choice to collect data of a risk-free rate from Ken French's data library is due to the fact that they provide the time-series needed for the research. Furthermore, it is a trustworthy database built by a renowned professor, namely Ken French. Moreover, Daniel and Moskowitz (2016) use this database for their study. The market return is gathered from CRSP which is a database for the American stock market. Since CRSP gathers data from the NYSE, Nasdaq, Amex etc., it can give a reliable market return through its value-weighted portfolio.

5. Analysis and Findings

The following section will include a presentation of results for the hypothesis tests and regression models followed by a discussion.

5.1. Hypothesis Testing Results

5.1.1. The Whole Period

5.1.1.1 Cumulative return

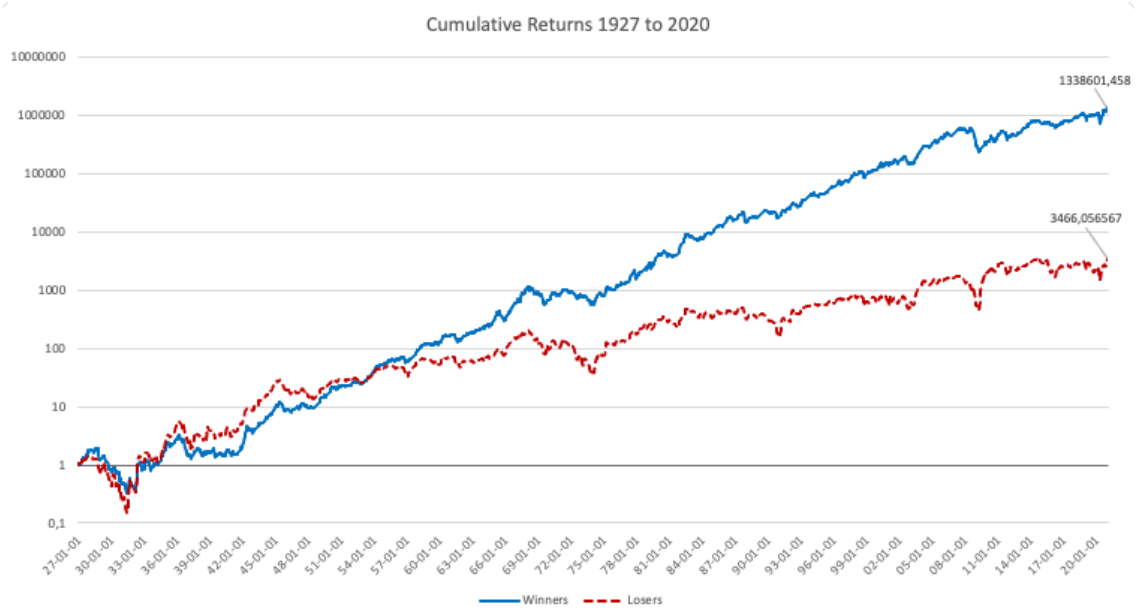

Figure 1. Cumulative return between 1927 to 2020.

The cumulative return over the entire period starts from 1 dollar invested in 1927. As previously mentioned, the formation and holding period for this graph are both six months. Moreover, a logarithmic scale is used on the y-axis to make the graph easier to interpret. The loser portfolio ends at a return of 3,466 times while the winner portfolio ends at 1,338,601 times the money. This outperformance will be discussed later, see section 5.2. Discussion and Critical Reflection.

5.1.1.2 Jegadeesh table

A cell marked with * indicates a significance level of at least 95% ($-1.96 \geq t \geq 1.96$) or ($p \leq 0.05$)

Period of 1927 to 1950.

J	**K=**	**3**	**6**	**9**	**12**
3 *Sell*		2.88%	2.38%	2.23%	2.09%
(t-statistic)		(3.03)*	(2.54)*	(2.42)*	(2.28)*
3 *Buy*		1.00%	1.37%	1.56%	1.69%
(t-statistic)		(1.56)	(2.16)*	(2.43)*	(2.56)*
3 *Buy-Sell*		-1.88%	-1.01%	-0.64%	-0.40%
(t-statistic)		(-3.63)*	(-2.24)*	(-1.58)*	(-1.07)*
6 *Sell*		2.76%	2.22%	2.02%	2.05%
(t-statistic)		(2.73)*	(2.29)*	(2.10)*	(2.15)*
6 *Buy*		1.16%	1.55%	1.72%	1.66%
(t-statistic)		(1.96)*	(2.52)*	(2.72)*	(2.63)*
6 *Buy-Sell*		-1.60%	-0.67%	-0.30%	-0.39%
(t-statistic)		(-2.46)*	(-1.17)	(-0.57)	(-0.79)
9 *Sell*		2.45%	2.02%	2.01%	2.11%
(t-statistic)		(2.41)*	(2.01)*	(2.01)*	(2.12)*
9 *Buy*		1.41%	1.68%	1.67%	1.57%
(t-statistic)		(2.34)*	(2.74)*	(2.68)*	(2.55)*
9 *Buy-Sell*		-1.04%	-0.34%	-0.34%	-0.54%
(t-statistic)		(-1.51)	(-0.53)	(-0.56)	(-0.93)
12 *Sell*		2.26%	2.12%	2.15%	2.28%
(t-statistic)		(2.14)*	(2.02)*	(2.07)*	(2.20)*
12 *Buy*		1.67%	1.64%	1.56%	1.43%
(t-statistic)		(2.80)*	(2.76)*	(2.60)*	(2.42)*
12 *Buy-Sell*		-0.59%	-0.48%	0.59%	-0.85%
(t-statistic)		(-0.82)	(-0.69)	(-0.89)	(-1.31)

Table 1. Buy-sell table between 1927 to 1950.

Period of 1950 to 1985.

J	**K=**	**3**	**6**	**9**	**12**
3 *Sell*		1.15%	1.01%	1.03%	1.00%
(t-statistic)		(3.19)*	(2.89)*	(3.00)*	(2.98)*
3 *Buy*		1.41%	1.53%	1.53%	1.56%
(t-statistic)		(5.04)*	(5.37)*	(5.35)*	(5.40)*
3 *Buy-Sell*		0.26%	0.52%	0.50%	0.56%
(t-statistic)		(1.22)	(2.85)*	(3.16)*	(4.08)*
6 *Sell*		1.02%	0.95%	0.91%	0.98%
(t-statistic)		(2.72)*	(2.61)*	(2.59)*	(2.80)*
6 *Buy*		1.71%	1.73%	1.72%	1.63%
(t-statistic)		(5.98)*	(5.98)*	(5.89)*	(5.62)*
6 *Buy-Sell*		0.69%	0.79%	0.81%	0.66%
(t-statistic)		(2.76)*	(3.51)*	(4.16)*	(3.58)*
9 *Sell*		0.99%	0.86%	0.93%	1.02%
(t-statistic)		(2.60)*	(2.37)*	(2.59)*	(2.86)*
9 *Buy*		1.81%	1.81%	1.70%	1.59%
(t-statistic)		(6.21)*	(6.13)*	(5.76)*	(5.42)*
9 *Buy-Sell*		0.83%	0.95%	0.77%	0.57%
(t-statistic)		(3.15)*	(4.15)*	(3.55)*	(2.81)*
12 *Sell*		0.80%	0.82%	0.91%	1.00%
(t-statistic)		(2.09)*	(2.18)*	(2.44)*	(2.70)*
12 *Buy*		1.82%	1.71%	1.61%	1.50%
(t-statistic)		(6.02)*	(5.67)*	(5.33)*	(4.98)*
12 *Buy-Sell*		1.02%	0.89%	0.70%	0.50%
(t-statistic)		(3.94)*	(3.63)*	(3.01)*	(2.24)*

Table 2. Buy-sell table between 1950 to 1985.

Period of 1985 to 2020.

J	**K=**	**3**	**6**	**9**	**12**
***3** Sell*		1.24%	1.07%	1.07%	1.03%
(t-statistic)		(2.68)*	(2.40)*	(2.43)*	(2.44)*
***3** Buy*		1.15%	1.20%	1.24%	1.24%
(t-statistic)		(3.96)*	(4.07)*	(4.23)*	(4.17)*
***3** Buy-Sell*		-0.09%	0.13%	0.16%	0.20%
(t-statistic)		(-0.29)	(0.47)	(0.65)	(0.95)
***6** Sell*		1.11%	1.04%	1.02%	1.09%
(t-statistic)		(2.24)*	(2.13)*	(2.16)*	(2.39)*
***6** Buy*		1.32%	1.33%	1.33%	1.26%
(t-statistic)		(4.57)*	(4.61)*	(4.59)*	(4.35)*
***6** Buy-Sell*		0.21%	0.30%	0.31%	0.17%
(t-statistic)		(0.56)	(0.84)	(1.01)	(0.62)
***9** Sell*		1.12%	1.01%	1.08%	1.17%
(t-statistic)		(2.14)*	(2.02)*	(2.21)*	(2.45)*
***9** Buy*		1.47%	1.43%	1.35%	1.25%
(t-statistic)		(5.11)*	(4.91)*	(4.67)*	(4.33)*
***9** Buy-Sell*		0.34%	0.43%	0.28%	0.08%
(t-statistic)		(0.84)	(1.15)	(0.81)	(0.26)
***12** Sell*		1.08%	1.12%	1.21%	1.29%
(t-statistic)		(2.04)*	(2.16)*	(2.38)*	(2.60)*
***12** Buy*		1.29%	1.23%	1.17%	1.11%
(t-statistic)		(4.39)*	(4.17)*	(4.00)*	(3.80)*
***12** Buy-Sell*		0.21%	0.11%	−0.04%	-0.18%
(t-statistic)		(0.51)	(0.29)	(-0.10)	(-0.52)

Table 3. Buy-sell table between 1985 to 2020.

These tables are inspired by Jegadeesh and Titman (1993), where K is the holding time of the portfolio and J is the formation period. The returns during 1950 to 2020 for all portfolio options shows that the momentum strategy is successful. The winner portfolios have higher returns than the loser portfolios and the WML portfolios are positive. However, the time period between 1927 to 1950 stands out and has the opposite result. This will be discussed later in the thesis. The t-statistics are very high on most results and for the buyer portfolio only the portfolio with a formation period of 3 months and a holding period of 3 months during 1927 to 1950 are under the 95 % confidence interval, indicated by the t-statistic of 1.56. The data collected prior to 1950 mainly has two issues. One of them is the zigzag effect and another is the long period of financial instability during the Great Depression, as previously discussed. That is why this interval is separately collected and observed. This can also be an explanation as to why the only observation of a lower confidence interval than 95 % is found during this period of time. For the selling portfolios and WML portfolios the t-statistic results are a bit lower, although most results are on a high confidence level. As previously mentioned, the tables are divided into three time periods as the code running these tests cannot hold enough data to fulfil a test off the entire period at once. However, as mentioned there is an advantage with having the period of 1927 to 1950 separated.

5.1.1.3 Linear Regression

Portfolio(time)	P1 (27-50)	P10 27-50)	WML (27-50)	P1 (50-85)	P10 (50-85)	WML (50-85)	P1 (85-20)	P10 85-20)	WML (85-20)
Excess return	0.027%	0.027%	0.027%	1.067%	1.067%	1.067%	1.137%	1.137%	1.137%
Beta	1.729	1.187	−0.542	1.396	1.277	−0.120	1.579	1.152	−0.427
Alpha	0.009	0.006	−0.002	−0.005	0.004	0.009	−0.005	0.002	0.007
Error term	0.069	0.034	0.067	0.059	0.036	0.055	0.079	0.034	0.076
Standard deviation	0.161	0.102	0.096	0.076	0.060	0.046	0.101	0.060	0.073
R square	0.699	0.820	0.195	0.565	0.743	0.011	0.484	0.731	0.068
Skewness	3.023	0.357	−2.642	2.330	0.101	−2.298	2.586	0.446	−2.767
T-statistic	25.202*	35.217*	−8,138*	23.619*	35.214*	−2.178*	20.077*	34.170*	−5.607*
P-value	0.000*	0.000*	0.000*	0.000*	0.000*	0.030*	0.000*	0.000*	0.000*
CAPM	0.947%	0.632%	−0.215%	0.989%	1.762%	0.773%	1.295%	1.509%	0.214%

Table 4. Linear regression between 1927 to 2020.

As can be seen even more clearly in the linear regression, the period of 1927 to 1950 distinguishes when it comes to the WML performance. A small negative return of 0.02 % in average per month is calculated from the regression using CAPM framework with p-value of 0.00, leading to the only negative WML portfolio return that the three parts of the whole period holds. The linear model results in a return by using CAPM.

To clarify, between 1985 to 2020 the WML portfolio CAPM return is calculated as follows:

$$r = 0.7\% - 0.427 * 1.137\% = 0.214\%$$

Precisely as Jegadeesh and Titman explains in their research from 1993, during the period between 1965 to 1989 the momentum investing strategy performed well. This thesis shows that under the time period 1950 to 1985 the WML portfolio yields 0.8 % per month with a p-value of 0.030 which implies that the momentum investing strategy is successful.

5.1.2. Crises Periods

5.1.2.1 The Great Depression from 1930 to 1939

J	**K=**	**3**	**6**	**9**	**12**
3 *Sell*		4.25%	3.52%	3.10%	2.82%
(t-statistic)		(0.27)	(1.79)	(1.61)	(1.46)
3 *Buy*		0.34%	0.78%	1.32%	1.52%
(t-statistic)		(2.15)*	(0.63)	(1.01)	(1.16)
3 *Buy-Sell*		-3.90%	-2.74%	-1.78%	-1.30%
(t-statistic)		(-3.77)*	(-2.92)*	(2.10)*	(1.64)
6 *Sell*		4.52%	3.46%	2.95%	2.84%
(t-statistic)		(2.12)*	(1.69)	(1.45)	(1.41)
6 *Buy*		0.16%	1.02%	1.44%	1.43%
(t-statistic)		(0.14)	(0.87)	(1.19)	(1.17)
6 *Buy-Sell*		-4.36%	-2.43%	-1.51%	-1.41%
(t-statistic)		(-3.22)*	(-2.00)*	(1.33)	(1.34)
9 *Sell*		3.91%	3.07%	2.84%	2.84%
(t-statistic)		(1.82)	(1.44)	(1.34)	(1.34)
9 *Buy*		0.86%	1.36%	1.48%	1.43%
(t-statistic)		(0.75)	(1.17)	(1.25)	(1.21)
9 *Buy-Sell*		-3.05%	-1.71%	-1.35%	-1.41%
(t-statistic)		(-2.11)*	(-1.24)	(-1.04)	(-1.14)
12 *Sell*		4.42%	3.92%	3.76%	3.88%
(t-statistic)		(1.81)	(1.62)	(1.57)	(1.62)
12 *Buy*		1.51%	1.64%	1.78%	1.66%
(t-statistic)		(1.28)	(1.37)	(1.45)	(1.37)
12 *Buy-Sell*		-2.91%	-2.28%	-1.97%	-2.22%
(t-statistic)		(-1.75)	(-1.42)	(-1.29)	(-1.46)

Table 5. Buy-sell table between 1930 to 1939.

Portfolio(time)	P1 (30-39)	P10 30-39)	WML (30-39)
Excess return	−0.946%	−0.946%	−0.946%
Beta	1.844	1.127	−0.717
Alpha	0.024	0.005	−0.020
Error term	0.100	0.045	0.096
Standard deviation	0.223	0.128	0.132
R square	0.745	0.842	0.321
Skewness	2.181	0.115	−1.775
T-statistic	18.485*	24.994*	−7.443*
P-value	0.000*	0.000*	0.000*
CAPM	0.656%	−0.566%	−1.322%

Table 6. Linear regression between 1930 to 1939.

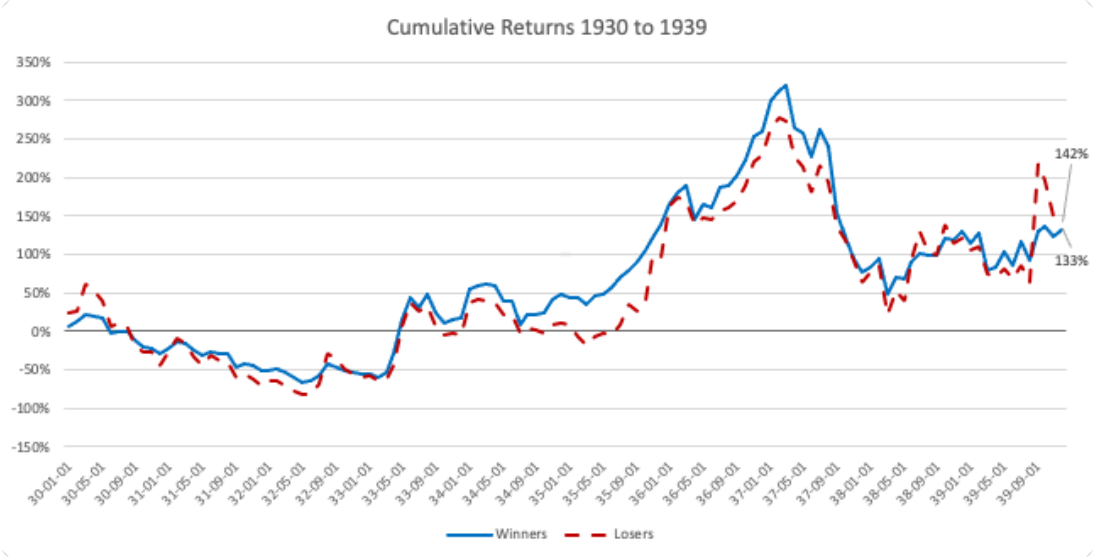

Figure 2. Cumulative return between 1930 to 1939.

The great depression lasted during the entire 1930s. Due to the stock market consisting of fewer stocks than later periods, lower confidence levels are observed in table 6. Every WML portfolio observed during this time period yields a negative return and, in many cases, an excessively negative return. For example, the buy-sell portfolio with a formation period of 6 months and a holding period of 3 months experiences an average return of -4.36 % per month during the entire 1930s with a t-statistic of -3.22. The two portfolios follow each other throughout the decade and a clear outperformance is hard to observe from the cumulative graphs, the loser portfolio yields a bit more positive return than the winners. The linear regression gives a result in the same direction with a small negative WML of 0.2 % on average per month, with a p-value of 0.00.

5.1.2.2 IT-bubble from 2002 to 2003

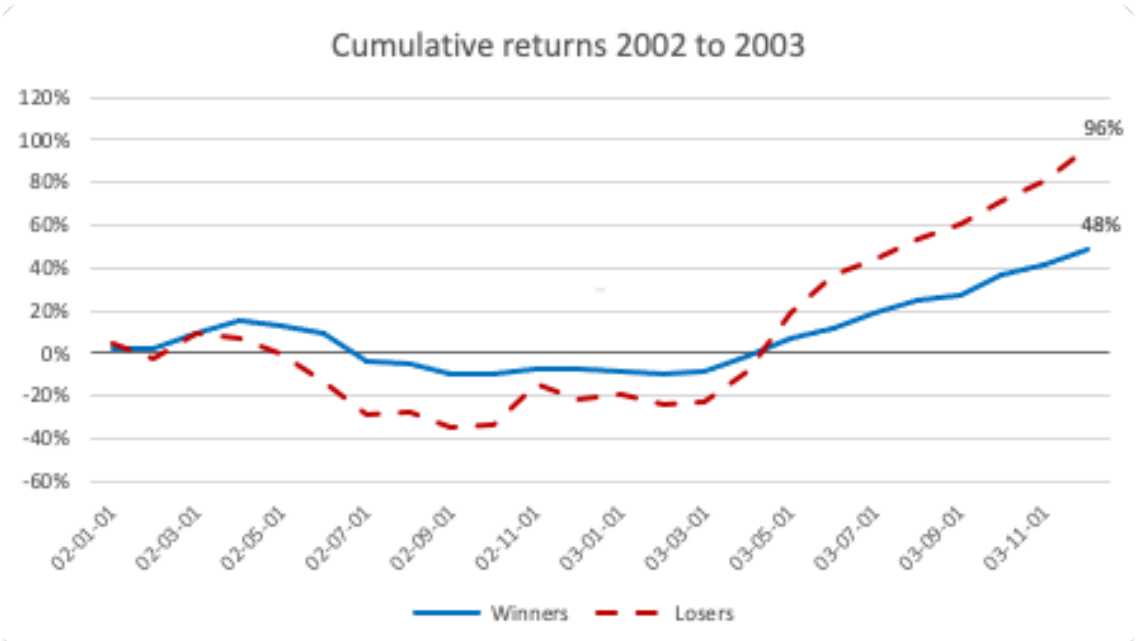

Figure 3. Cumulative return between 2002 to 2003.

J	**K=**	**3**	**6**	**9**	**12**
3 *Sell*		3.05%	2.91%	3.04%	2.97%
(t-statistic)		(1.41)	(1.39)	(1.46)	(1.46)
3 *Buy*		2.38%	2.32%	2.17%	2.12%
(t-statistic)		(1.96)*	(1.86)	(1.81)	(1.80)
3 *Buy-Sell*		-0.67%	-0.59%	-0.87%	-0.86%
(t-statistic)		(-0.52)	(-0.50)	(-0.75)	(-0.83)
6 *Sell*		3.07%	3.16%	3.19%	3.25%
(t-statistic)		(1.32)	(1.38)	(1.41)	(1.45)
6 *Buy*		2.22%	2.00%	1.94%	1.86%
(t-statistic)		(1.97)*	(1.79)	(1.81)	(1.74)
6 *Buy-Sell*		-0.84%	-1.16%	-1.24%	-1.39%
(t-statistic)		(-0.52)	(-0.74)	(-0.86)	(-0.99)
9 *Sell*		3.55%	3.40%	3.46%	3.58%
(t-statistic)		(1.44)	(1.40)	(1.45)	(1.51)
9 *Buy*		2.05%	1.91%	1.77%	1.69%
(t-statistic)		(1.99)*	(1.91)	(1.79)	(1.66)
9 *Buy-Sell*		-1.50%	-1.49%	-1.69%	-1.90%
(t-statistic)		(-0.80)	(-0.84)	(-0.99)	(-1.16)
12 *Sell*		8.49%	8.64%	8.71%	8.78%
(t-statistic)		(3.02)*	(3.17)*	(3.16)*	(3.13)*
12 *Buy*		3.93%	3.72%	3.73%	3.72%
(t-statistic)		(4.08)*	(3.79)*	(3.69)*	(3.47)*
12 *Buy-Sell*		-4.56%	-4.92%	-4.98%	-5.07%
(t-statistic)		(-2.04)*	(-2.13)*	(-2.34)*	(-2.34)*

Table 7. Buy-sell table between 2002 to 2003.

Portfolio(time)	P1 (02-03)	P10 (02-03)	WML (02-03)
Excess return	−1.658%	−1.658%	−1.658%
Beta	1.899	0.824	−1.075
Alpha	0.024	0.016	−0.008
Error term	0.263	0.156	0.238
Standard deviation	0.113	0.055	0.076
R square	0.713	0.572	0.493
Skewness	0.440	−0.494	−1.217
T-statistic	7.221*	5.293*	−4.515*
P-value	0.000*	0.000*	0.000*
CAPM	−0.749%	0.233%	0.982%

Table 8. Linear regression between 2002 to 2003.

The crisis of 2002 to 2003 clearly illustrates the risk of trading in accordance with momentum strategy in times of financial crisis. As the cumulative graph displays the loser portfolio outperforms the winner portfolio by twice the return over the two-year period. Another proof of this is the buy-sell table where none of the 16 different WML portfolios have a positive return. The most negative WML is the portfolio with both a formation and holding period of 12 months that yields a negative return of 5.07 % with a t-statistic of -2.34. The least negative WML that reaches a significance level of at least 5 % is the portfolio with a formation period of 12 months and a holding period of 3 months that yields a negative return of -4.56 % with a t-statistic of -2.04. On average the winners gain 1.94 % per month while the losers gain 3.19 % per month, displayed in the portfolio with both a formation and a holding period of 6 months. The linear regression made on this period gives a positive monthly return for the WML with 1 % on average, with p-value of 0.00. This result is not in accordance with other literature or tests performed in this thesis. The answer to this might be in the large unexplained variability (R square 0.493; standard error 0.238), which will be discussed under section 5.2.1.

5.1.2.3 Financial Crisis from 2008 to 2009

J	**K=**	**3**	**6**	**9**	**12**
3 *Sell*		2.25%	2.63%	2.63%	2.56%
(t-statistic)		(0.62)	(0.74)	(0.75)	(0.75)
3 *Buy*		0.24%	-0.54%	-0.66%	-0.48%
(t-statistic)		(0.12)	(-0.26)	(-0.32)	(-0.23)
3 *Buy-Sell*		-2.01%	-3.17%	-3.29%	-3.04%
(t-statistic)		(-0.88)	(-1.41)	(-1.63)	(-1.73)
6 *Sell*		3.59%	3.69%	3.40%	3.16%
(t-statistic)		(0.89)	(0.93)	(0.89)	(0.87)
6 *Buy*		-1.10%	-1.48%	-1.31%	-0.98%
(t-statistic)		(-0.58)	(-0.79)	(-0.70)	(-0.51)
6 *Buy-Sell*		-4.70%	-5.16%	-4.71%	-4.13%
(t-statistic)		(-1.44)	(-1.69)	(-1.79)	(-1.84)
9 *Sell*		4.44%	4.08%	3.72%	3.46%
(t-statistic)		(1.02)	(1.00)	(0.95)	(0.93)
9 *Buy*		-1.64%	-1.79%	-1.52%	-1.28%
(t-statistic)		(-0.93)	(-1.00)	(-0.85)	(-0.69)
9 *Buy-Sell*		-6.08%	-5.89%	-5.24%	-4.75%
(t-statistic)		(-1.68)	(-1.81)	(-1.89)	(-1.96)*
12 *Sell*		15.56%	15.22%	14.34%	13.43%
(t-statistic)		(2.30)*	(2.45)*	(-2.84)*	(2.42)*
12 *Buy*		0.84%	1.07%	1.71%	2.33%
(t-statistic)		(0.49)	(0.63)	(0.94)	(1.18)
12 *Buy-Sell*		−14.72%	-14.15%	-12.64%	-11.10%
(t-statistic)		(-2.49)*	(-2.74)*	(-2.84)*	(-2.77)*

Table 9. Buy-sell table between 2008 to 2009.

Portfolio(time)	P1 (08-09)	P10 08-09)	WML 08-09)
Excess return	−1.610%	−1.610%	−1.610%
Beta	1.307	0.052	−1.255
Alpha	0.031	−0.011	−0.043
Error term	0.800	0.392	0.586
Standard deviation	0.194	0.090	0.148
R square	0.113	0.001	0.179
Skewness	0.171	−0.928	−0.991
T-statistic	1.633	0.133	−2.142*
P-value	0.117	0.896	0.044*
CAPM	0.995%	−1.184%	−2.279%

Table 10. Linear regression between 2008 to 2009.

Figure 4. Cumulative return between 2008 to 2009.

All portfolios displayed at the buy-sell with a shorter formation period than 12 months do not reach the desired significance level. When observing the significant portfolios, it is evident that the WML portfolios are vastly negative. For instance, a six month holding period yields a negative return of 14.15 % with a t-statistic of -2.74. This indicates that the momentum investing strategy would not have been a good strategy throughout this crisis. Further, the cumulative results indicate what the previous crises have shown. The loser portfolio clearly outperforms the winner portfolio. During this crisis the winner portfolio has a cumulative return of -37 % while the loser portfolio has a cumulative return of 64 %. The linear regression proves that the WML gives negative monthly returns of -2.279 % on average with a p-value of 0.00.

5.1.2.4 Covid Crisis from 2019 to 2020

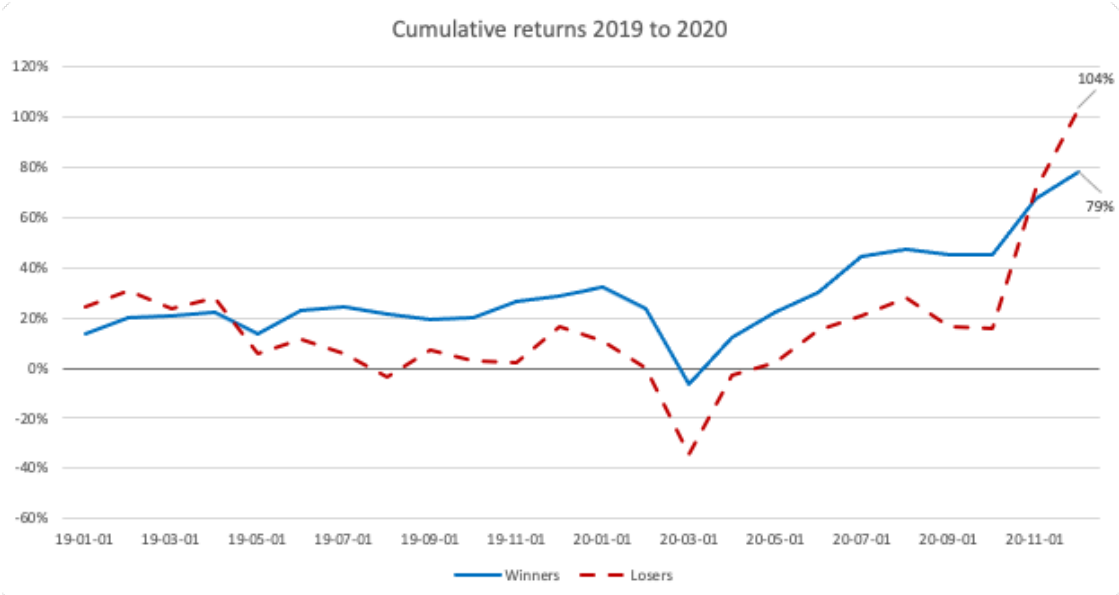

Figure 5. Cumulative return between 2019 to 2020.

J	**K=**	**3**	**6**	**9**	**12**
3 *Sell*		4.07%	3.33%	3.64%	3.63%
(t-statistic)		(1.23)	(1.05)	(1.15)	(1.15)
3 *Buy*		2.66%	2.96%	2.91%	2.79%
(t-statistic)		(1.33)	(1.42)	(1.46)	(1.38)
3 *Buy-Sell*		-1.41%	-0.37%	-0.73%	-0.84%
(t-statistic)		(-0.77)	(-0.24)	(-0.45)	(-0.59)
6 *Sell*		3.61%	3.87%	4.10%	4.00%
(t-statistic)		(1.03)	(1.08)	(1.16)	(1.18)
6 *Buy*		2.68%	2.81%	2.73%	2.72%
(t-statistic)		(1.39)	(1.49)	(1.47)	(1.47)
6 *Buy-Sell*		−0.94%	-1.06%	-1.38%	-1.29%
(t-statistic)		(-0.44)	(-0.48)	(-0.66)	(-0.69)
9 *Sell*		4.56%	4.46%	4.48%	4.42%
(t-statistic)		(1.17)	(1.18)	(1.20)	(1.23)
9 *Buy*		2.79%	2.81%	2.82%	2.73%
(t-statistic)		(1.63)	(1.54)	(1.58)	(1.56)
9 *Buy-Sell*		-1.76%	-1.65%	-1.65%	-1.68%
(t-statistic)		(-0.67)	(-0.67)	(-0.71)	(-0.78)
12 *Sell*		7.84%	7.13%	7.14%	7.06%
(t-statistic)		(1.12)	(1.03)	(1.04)	(1.07)
12 *Buy*		2.59%	2.89%	3.06%	3.04%
(t-statistic)		(0.80)	(0.89)	(1.00)	(1.00)
12 *Buy-Sell*		-5.24%	-4.24%	-4.08%	-4.01%
(t-statistic)		(-1.17)	(-1.00)	(-0.95)	(-1.01)

Table 11. Buy-sell table between 2019 to 2020.

Portfolio(time)	P1 (19-20)	P10 (19-20)	WML (19-20)
Excess return	−0.448%	−0.448%	−0.448%
Beta	0.544	0.453	−0.092
Alpha	0.028	0.022	−0.006
Error term	0.732	0.379	0.459
Standard deviation	0.170	0.090	0.105
R square	0.026	0.064	0.002
Skewness	0.718	−1.079	−1.218
T-statistic	0.743	1.195	−0.200
P-value	0.466	0.246	0.843
F-statistic	0.553	1.427	0.040
CAPM	2.556%	1.997%	−0.559%

Table 12. Linear regression between 2019 to 2020.

During this time period, nothing can be proved with statistical significance. The Jegadeesh table does not have t-statistics over or below ± 1.96 and the linear regression does not yield significant results either. However, the results point towards the same outcome as previous crises where WML is negative, and momentum does not perform desirable results. Moreover, the cumulative graph displays a small victory for the loser portfolio, which is not bringing much clarity to the results. However, two of the 15 worst WML results during the century can be found during this crisis, which is presented further under section 5.1.4. 15 Worst WML Portfolios.

5.1.3. Last decade

5.1.3.1 Jegadeesh table

J	**K=**	**3**	**6**	**9**	**12**
***3** Sell*		1.19%	1.01%	1.00%	0.98%
(t-stat)		(1.41)	(1.23)	(1.21)	(1.23)
***3** Buy*		0.95%	1.11%	1.22%	1.17%
(t-stat)		(1.72)	(1.92)	(2.14)*	(2.03)*
***3** Buy-Sell*		-0.24%	0.10%	0.22%	0.19%
(t-stat)		(-0.51)	(0.24)	(0.54)	(0.55)
***6** Sell*		1.07%	1.00%	0.97%	1.00%
(t-stat)		(1.19)	(1.10)	(1.10)	(1.17)
***6** Buy*		1.21%	1.28%	1.26%	1.22%
(t-stat)		(2.18)*	(2.29)*	(2.24)*	(2.17)*
***6** Buy-Sell*		0.14%	0.29%	0.29%	0.23%
(t-stat)		(0.23	(0.51)	(0.56)	(0.49)
***9** Sell*		0.99%	0.93%	0.96%	1.01%
(t-stat)		(1.02)	(1.00)	(1.05)	(1.14)
***9** Buy*		1.38%	1.33%	1.32%	1.26%
(t-stat)		(2.57)*	(2.36)*	(2.35)*	(2.28)*
***9** Buy-Sell*		0.39%	0.40%	0.35%	0.26%
(t-stat)		(0.59)	(0.65)	(0.61)	(0.48)
***12** Sell*		0.84%	0.82%	0.86%	0.91%
(t-stat)		(0.82)	(0.82)	(0.87)	(0.95)
***12** Buy*		0.97%	1.02%	1.06%	1.04%
(t-stat)		(1.80)	(1.86)	(1.97)*	(1.92)
***12** Buy-Sell*		0.13%	0.20%	0.20%	0.13%
(t-stat)		(0.18)	(0.30)	(0.31)	(0.22)

Table 13. Buy-sell table between 2010 to 2020.

The momentum investing strategy has performed rather well during the last decade. Where significant results are reached, the maximum return for the buyer portfolio is 1.38 %. This result is reached through a formation period of 9 months and a holding period of 3 months. Furthermore, the minimum significant return is 1.06 %, achieved through a formation period of 12 months and a holding period of 9 months. Nothing can be said with significance about the WML portfolios or the loser portfolio, but all results point in the same direction, that the loser portfolio performs worse than the winner.

5.1.3.3 Regression

Portfolio(time)	P1 (10-20)	P10 (10-20)	WML (10-20)
Excess return	1.903%	1.903%	1.903%
Beta	2.015	1.389	−0.626
Alpha	−0.013	−0.003	0.010
Error term	0.128	0.059	0.125
Standard deviation	0.104	0.064	0.065
R square	0.658	0.810	0.162
Skewness	0.921	−0.060	−0.879
T-statistic	15.746*	23.427*	−4.990*
P-value	0.000*	0.000*	0.000*
CAPM	2.535%	2.343%	−0.192%

Table 14. Linear regression between 2010 to 2020.

The regression shows with significance that the WML portfolio yields a negative result, which contrasts the previous findings. This regression as well as the regression done over the period of 2002 to 2003 stands out when it comes to standard error and R square, which will be discussed further in section 5.2.1.

5.1.3.2 Cumulative Return

Figure 6. Cumulative return between 2010 to 2020.

For the cumulative results it is more evident that the momentum investing strategy is successful during the last decade. A very clear outperformance is found where one dollar invested in the winner portfolio in January 2010 is worth 4.09 dollars in December 2020 and one dollar invested in the loser portfolio is worth 1.9 dollars for the same investment period.

5.1.4. 15 Worst WML Portfolio Returns

Date	WML return
1939-09 *	−72.88%
1932-08 *	−62.22%
2001-01 ‡	−53.91%
1933-05 *	−53.31%
2009-04 ❧	−51.60%
1932-07*	−43.19%
1975-01	−37.20%
1992-01	−36.70%
2009-03 ❧	−31.60%
1991-02	−31.10%
1938-06 *	−28.93%
2020-11 ▪	−28.24%
1974-01	−26.43%
1942-01	−25.96%
2020-04 ▪	−25.58%

Table 15. 15 worst WML portfolio returns between 1927 to 2020.

The asterixis indicates that the date is within one of the defined crises periods. The symbol * represents the Great Depression. The ‡ represents the IT-crash of 2002-2003 whilst the symbol ❧ represents the financial crisis 2008-2009. The Covid crisis is indicated using the symbol ▪.

Five observations are found during the Great depression with a lowest return of -72.88 %. The IT-crash is also represented in this table with one observation namely January 2001 that has a return of -53.91 %. The financial crisis is also represented here with one observation of -31.6 %. At last, the Covid crisis qualifies with two observations, where the lowest is -28.24 % in November 2020. Other observations can be explained by different market instabilities, but since that is not a part of this thesis these observations will only be discussed briefly.

5.2. Discussion and Critical Reflection

The following section will contain a discussion of the results that are displayed in section 5.1. Hypothesis Testing Results.

5.2.1. Discussion of the Findings

When examining the results of the 15 worst WML portfolios it can be found that all of the more effectful crises are represented in the table, namely the Great Depression, the IT-crash and the 2008 financial crisis. Even the Covid crisis is represented, which is included due to this thesis prolonged time window. The three most effectful crises are also at the top of the list, representing all of the WML portfolios that are above 40 % minus. This indicates that following the momentum strategy during periods of financial crisis might not be a good strategy since the investor will lose money. Apart from the mentioned crises, the list also represents dates during the second world war, the 1970s oil crisis and the early 1990s recession. Even though there were no crises in the stock market during the Second World War, incidents during the war may have led to a momentary decrease in the stock market. Therefore, this result can be explained due to worldly events that affect the stock market. The oil crisis is categorised as a crisis, although it may not be one of the largest. Thus, it is not surprising that it is represented on the list. The early 1990s recession is not a crisis, since it only lasted 8 months (see section 2.2.2. Financial Crises). The recession may however explain the negative observations during this period of time, even though it is not a crisis. Overall, the results show that all of the displayed returns are negative, indicating that following the momentum strategy during these time periods would have led to a loss of invested capital. Since two thirds of the 15 worst WML portfolios occur during the selected crises and four fifths are during crises periods, the results suggest that momentum strategy is unfavourable during a financial crisis.

The buy-sell tables, inspired by Jegadeesh and Titman's article (1993), display a few interesting findings. Firstly, by looking closer at the crisis tables, it is found that all of the buy-sell portfolios are negative. This means that even though you change the length of your observation and holding period for the portfolios, the results will still be negative during the crises. Secondly, the period before the 1950s resulted in a lot of negative returns for the buy-sell portfolio. This could possibly be explained due to both the zigzag data (See section 4.2. Time Windows) as well as the fact that a large amount of the time period is represented by the great depression. Both of them might have affected the result. When comparing the result of the period before the 1950s to the result of the Great Depression, the thesis finds the former to be less negative than the latter. This might disclose that the results of the momentum strategy are positive during the period before the 1950s if one excludes the period of the Great Depression. Thirdly, we see that the time periods after the 1950s are mostly positive for all observation and holding periods. Even the last decade can be attributed the same outlook with only one negative WML portfolio, of a formation and holding period of 3 month, even though neither of this period's WML portfolio returns are statistically significant. Overall, this proves that the momentum strategy is a good strategy to follow over all for capital investments and that by following the momentum strategy one receives a positive return on investments. In general, the conclusion that can be drawn by looking at the buy-sell

tables is that the momentum strategy works over long time periods but does not perform desirable during times of crises. The t-statistics that are displayed also provides a chance to test the hypothesis of this thesis. Most of the t-statistics in the table for the whole period of 1927 to 2020 is significant. This indicates that the null hypothesis for the whole period can be rejected, especially since 16 distinct tests have been run. To this should be added the cumulative return and linear regression before the null hypothesis can be evaluated. The tests even produce a t-statistic as high as 6.21 for the winner portfolio during 1950 to 1985 with a formation period of 9 months and a holding period of 3 months. This specific portfolio produces a return of 1.81 %, with a statistical significance.

The cumulative returns have also been plotted into graphs. These graphs have different characteristics worth discussing. Regarding the whole period, the cumulative return for the winner's portfolio begins below the losers return. After the Great Depression and when moving into the 1950s, their positions changed, and the winners are thereafter above the losers. Thus, the end result for the cumulative return indicates a positive WML return. The graph of the Great Depression shows a winner and loser portfolio with cumulative returns that are close to each other. Consequently, it is not given that the investor will earn money using the momentum strategy during this time period. When continuing by examining the IT-bubble and the financial crisis of 2008 to 2009, both periods display a loser portfolio that has increasing returns at the end of the crisis period, which leads to a clearly higher return than what the winning portfolio displays during this time period. Therefore, to apply the momentum strategy during the end of the crises would lead to a negative WML return. The cumulative graph for the Covid crisis presents a winner portfolio only slightly below the loser portfolio. Nevertheless, this is in the middle of the period and the uncertainty of the market still prevails into 2021. Hence, the limited data might be what causes the different attributes compared to the previously mentioned crises. Either way, the cumulative returns of the winners and losers during this period seem to be in proximity to each other. Further, both the winner and the loser portfolio are on high levels during the Covid crisis in comparison to the earlier crises. At last, cumulative returns during the last decade strongly emphasize that the momentum investing strategy is successful during this period. The winner returns 309 % of the investment while the loser reaches 90 % of the investment.

In regard to the linear regression, the betas for the loser portfolios are higher than the winner portfolios, which creates a negative beta for the WML portfolio. However, the beta for the WML portfolio is higher during the period of 1927 to 2020 than what it is during periods of crisis. This indicates that the WML portfolio follows the market better during the entire period than what it does during financial crises. During the crises, the beta is closer to -1, which means that a one-point improvement in the market return yields a negative one-point development in the WML portfolio. Therefore, when the market turns around and starts to recover after a crisis, the WML portfolio will experience a negative return, meaning that you lose money compared to if you would have invested in the market portfolio solely. Alpha in the linear model represents the average risk-free rate during the period, which is close to zero. When using these variables to calculate the CAPM, the thesis finds that for the entire period, all of the WML portfolios have a positive return except during the years of 1927 to 1950. This can be attributed both to the zigzag price changes as well as the Great Depression.

Moreover, the linear regression displayed that the error term and the R squared are relatively large compared to the other time periods. A high error term and R squared indicates that there is much unexplained variability to the model and therefore the model can be better fitted. Similar observations regarding the R squared and error term can be made regarding the last decade, which also experience a negative WML return. The weak fit of the model might be responsible for the contradicting results. Furthermore, the last decade has experienced turmoil in the form of both the Black Monday during 2011 and the current Covid crisis, which might also explain the results. The crisis periods experience a negative WML result in accordance with the buy-sell tables in all cases except for the IT-crash and the Covid crisis. These periods also experience a relatively high error term and R squared compared to the other crisis periods. Since the error term holds the unexplained variability in dependent variables and the R square indicates the fit of the model, these results indicate that the model might be poorly approximated for these time periods. The error term is overall higher during periods of financial crises than during the entire time period. Therefore, it might be more unexplained variability during these time periods. Overall, the CAPM seems to yield results that point in the same direction as the buy-sell models and previous research.

5.2.1.1. Hypothesis Consideration

The first null hypothesis, concerning momentum investing strategy during financial crises, will be rejected. The regressions show that the WML portfolios return are negative in all cases except the IT-crash crisis. The p-values are overall satisfying; the only p-value over 0.05 is during the Covid crisis. The IT-crash crisis does, as previously mentioned, obtain high error terms. This might explain the abnormal result and is the reason for why this thesis chose to not weight this result equally to the other. The Jegadeesh tables are satisfactory in accordance with the previous results. None of the WML portfolios with significance levels below 5 % has a positive return, including the IT-crash crisis with four significant observations. In all crisis periods the cumulative returns for the loser portfolios are higher than all the cumulative returns for the winner portfolios. Furthermore, the WML table shows that the most extreme results occur during these periods. With all this in mind, the study rejects the null hypothesis on a 5 % significance level. As a consequence, it stands clear that the momentum investing strategy does not return positive values during financial crises.

The second null hypothesis, concerning momentum investing strategy over the last century, can also be rejected with a low significance level. The result from the study shows that the WML portfolio throughout the century performs positive results with p-values spanning from zero to 0.03 in the regressions. The only concern is regarding the time period between 1927 and 1950. Although, 1927 to 1950 does include the great depression as well as the zigzag price changes, that are already discussed. These two factors influence the result and make it less reliable. Therefore, a negative result for this period is more understandable and should therefore not affect the judgement of the results to a great extent. The Jegadeesh tables together with the cumulative return clearly shows the positive return of trading in accordance with momentum investing strategy over long periods of time. Therefore, the thesis concludes that the null hypothesis can be rejected at a significance level at 5 %. As a consequence, momentum

investing strategy yields positive returns during the last century at a significance level of 5 %.

The third null hypothesis concerning momentum investing strategy over the last decade cannot be rejected. The regression gives a negative WML result which is in line with the null hypothesis. However, the regression has high error terms which makes the result more uncertain. Further, the Jegadeesh table points in the direction that the WML portfolios yield positive results but only one portfolio in the table has a significance level of below 5 %. The cumulative returns point towards a clear outperformance of the loser portfolio, but the overall results are not statistically significant enough to reject the null hypothesis on a 5 % significance level. As a consequence, momentum investing strategy cannot be concluded to yield neither positive nor non-positive returns during the last decade. However, the results, albeit non-significant, point towards positive returns.

5.2.2. Knowledge Contribution and Value of Thesis

When compared to previous studies, this thesis provides similar results. Firstly, it is indicated that momentum strategy holds during the last century. Secondly, it can be shown that momentum investing strategy is not preferable during crises. Both of these conclusions are in accordance with previous research. To be more precise, previous research has found that the loser portfolios have higher betas than the winner portfolios (Jegadeesh and Titman, 1993; Daniel and Moskowitz, 2016). This thesis has observed the same pattern, namely that loser portfolios tend to have higher betas than winner portfolios. For example, this thesis has a slightly lower beta for the WML than Jegadeesh and Titman (1993) which can be explained by the small difference in time periods, beta of -0.12 vs -0.08. Furthermore, the cumulative return during the entire time period is similar to what Daniel & Moskowitz's have found. The difference is most likely due to the difference in holding periods. While Daniel and Moskowitz (2016) hold their portfolios for one month, this research holds the portfolio for six months. Furthermore, Daniel and Moskowitz (2016) use daily prices as basis for their cumulative return whereas this thesis uses monthly prices.

However, this research contributes to the area of study by its extension in time frame and focus on crises during different portfolio constructions. By this extension, the results indicate that the Covid crisis follows the same pattern as previous crises. Moreover, the results point towards that the latest decade yields positive returns when investing in accordance with momentum investing strategy. One can see that the tables look very similar to the ones of Jegadeesh and Titman (1993). Since this research is made on different time periods, the results are slightly different and more significant, which is distinct from previous research. Furthermore, the cumulative returns move in the same direction as Daniel and Moskowitz (2016). Since the portfolios are not the same, the graphs cannot be identical, but the results do come to the same conclusion. What distinguishes this thesis from Daniel and Moskowitz (2016), is that this research has examined the last decade, where it is observable that the winners' cumulative returns outperform the losers. In brief, this thesis brings knowledge in the field since it captures new time periods including another crisis. Further, the thesis deepens the understanding of momentum since it applies Jegadeesh and Titman (1993) methodology on Daniel and Moskowitz (2016) cumulative methodology.

6. Conclusion

In conclusion, it can be said that momentum investing strategy is successful during longer time periods. The thesis finds that from the 1940s up until today, investing in the winner decile yields a return several times the market return for the same period. Investing one dollar in 1927 will yield 1,338,601 dollars at the end of year 2020 by using the momentum investing strategy.

Furthermore, the momentum investing strategy shows weak performance during financial crises. For all the periods that this thesis defines as crises, momentum investing yields very negative results. Although some results during crises are not statistically significant, they still point towards this conclusion. The worst WML performances can be found within these periods and not one single WML portfolio out of 16 portfolios in every time period (the great depression, the IT-crash, the financial crash and the Covid crash) has a positive return.

The thesis further concludes that the Covid crisis behaves similarly as the previous crashes have behaved. The momentum investing strategy fails during this period and the WML portfolio's only result in negative returns. Furthermore, two observations can be found during this period that qualifies for the table of the 15 worst WML returns during the entire time period of 1927 to 2020.

Finally, previous research has not examined the most recent decade. This thesis cannot show whether the momentum strategy holds or not during this decade due to the non-significant results, even though the generated results point towards the former. This uncertainty in the results can partly be explained by Black Monday in 2011 and, of course, the Covid crisis. However, the winner's decile outperforms the loser decile with more than three times the return, which indicates the power of the momentum investing strategy.

Hence, momentum is an investing strategy that can produce a high return during normal market conditions. However, the more volatile the market, the more risk is involved for the investor using the strategy. Therefore, this thesis does not discredit the use of the momentum investing strategy but cautions the investor regarding the risk of using the strategy during financial crises.

6.1. Future Research

Future research might improve this thesis by running the regression and the buy-sell table for the entire time period of 1927 to 2020. This improvement could be achieved with better resources than the authors of this thesis had in possession. One other aspect that could help improve this research is to use a larger sample. This thesis uses data from NYSE and Amex. However, stock markets such as Nasdaq and smaller markets have not been included in this research. Moreover, future research could isolate smaller listed firms and see if momentum holds for these stocks as well or if it only is successful on larger listed firms.

Another important aspect to take into consideration in future research would be the aspect of risk. As mentioned in the discussion, the crisis periods seem to have more unexplained variability on dependent variables. The unexplained variability might decrease if the model had an added risk variable. Furthermore, the Covid effects have not yet fully been disclosed. In a few years, data will be available for researchers that makes it possible to more clearly see the aftereffects on the Covid crisis.

Something this thesis does not take into consideration is lagged monthly returns. Jegadeesh and Titman (1993) as well as Daniel and Moskowitz (2016) take this into consideration, so it might be interesting to see how that would affect the results in this thesis. Additionally, even more variation in formation periods as well as holding periods could be used to increase the overview of the momentum investing strategy during different portfolio constructions. One could also investigate further by creating more narrow decile portfolios. For example, future research might investigate how the top 5 % and bottom 5 % react to the momentum strategy, if they perform even better as well as whether or not this will yield significant results.

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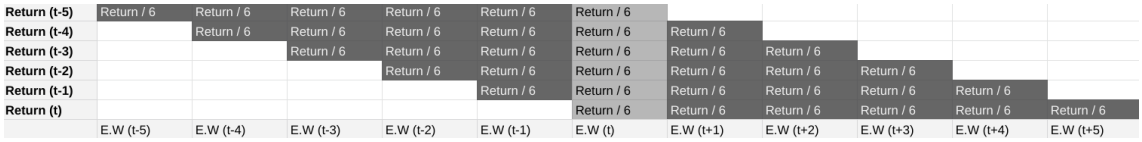
Appendix 1



The figure above explains the equally weighted portfolio during a holding period of 6 months. As depicted in the figure, the equally weighted portfolio consists of one sixth of every portfolio from the last five months, including the current month's return. The y-axis holds the return for every time period needed and the x-axis shows how the return moves with time. The light grey area is the return calculated in this specific case.