



Key performance drivers of stocks in varying market states

Lappeenranta–Lahti University of Technology LUT

Master's thesis in Strategic Finance and Business Analytics

2022

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ABSTRACT

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Master's thesis, 2022

72 pages, 17 figures, 42 tables and 0 appendices

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Keywords: Factor-investing, size, value, investment, profitability, operating leverage, financial leverage, cash holdings, momentum, market state, key performance drivers, Covid-19.

This thesis studies the key performance drivers of NYSE, NASDAQ and AMEX stocks in the 21st century. The research focuses on the characteristics of the companies that have under- or outperformed the market, the key performance drivers of stocks and the dependence of these key performance drivers on market state. The sample period of 2000 – 2021 is split into five subperiods: the ICT bubble, the economic boom, the financial crisis, the recovery period and the Covid-19 period. The key performance drivers are academically established factors including: value, size, leverage, profitability, investment, momentum and cash holdings. The differences in characteristics of the stocks in winner and loser portfolios are examined by means of Welch's t-tests. The market returns are calculated in five different ways as a robustness checks. Cross-sectional regressions are conducted with the Huber-White heteroscedasticity robust standard errors to find out how much of the total returns of these stocks are explained by the key performance drivers. The goal of this research is to gain additional insight to the market state of the Covid-19 subperiod by gathering information about the characteristics of winners and losers in varying market states and comparing that information to the Covid-19 subperiod.

The results show that in the ICT bubble and the Covid-19 subperiods, the chosen key performance drivers have a strong explanatory power on total returns. The key performance drivers' explanatory power is not very dependent on the market state but there are clear relationships between the characteristics of winners and losers and the state of the market. The results indicate that the Covid-19 period shares more characteristics with the financial crisis than the economic boom.

TIIVISTELMÄ

Lappeenrannan–Lahden teknillinen yliopisto LUT

LUT-kauppakorkeakoulu, Kauppatieteet

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Osakkeiden tärkeimmät suorituskykytekijät erilaisissa markkinatiloissa

Kauppatieteiden pro gradu -tutkielma, 2022

72 sivua, 17 kuvaa, 42 taulukkoa ja 0 liitettä

Tarkastajat: Professori Eero Pätäri, Professori Sheraz Ahmed

Avainsanat: Faktorisoituminen, koko, arvo, sijoittaminen, kannattavuus, kiinteiden kustannusten vipuvaikutus, taloudellinen vipuvaikutus, käteisvarat, momentum, markkinatila, tärkeimmät suorituskykytekijät, Covid-19.

Tämä tutkimus tutkii NYSE:n, NASDAQ:n ja AMEXin osakkeiden tärkeimpiä suorituskykytekijöitä 2000-luvulla. Tutkimus keskittyy markkinoita huonommin tai paremmin tuottaneiden yritysten ominaisuuksiin, osakkeiden keskeisiin suorituskykytekijöihin ja näiden keskeisten suorituskykytekijöiden riippuvuuteen markkinatilanteesta. Tutkittu ajanjakso 2000 – 2021 on jaettu viiteen osakauteen: IT-kupla, talousbuumi, finanssikriisi, elpyminen ja Covid-19. Tutkitut keskeiset suorituskykytekijät ovat akateemisesti perusteltuja tekijöitä, joita ovat: arvo, koko, vipuvaikutus, kannattavuus, investoinnit, momentum ja kassavarat. Voittaja- ja häviäjäsalkkujen osakkeiden ominaisuuksia tarkastellaan Welchin t-testeillä. Markkinatuotot lasketaan viidellä eri tavalla mallien tulosten robustisuuden tarkistuksena. Poikkileikkausregressiot suoritetaan Huber-Whiten heteroskedastisuusrobusteilla standardivirheillä, jotta saadaan selville, kuinka suuri osa näiden osakkeiden kokonaistuotoista selittyy tutkituilla suorituskykytekijöillä. Tämän tutkimuksen tavoitteena on saada lisätietoa Covid-19 aikajakson markkinatilanteesta keräämällä tietoa voittajien ja häviäjien ominaisuuksista eri markkinatiloissa ja vertaamalla näitä tietoja Covid-19-ajanjaksoon.

Tulokset osoittavat, että IT-kuplan ja Covid-19-alajaksojen aikana tutkituilla avaintekijöillä on suuri selitysvoima kokonaistuottoihin. Keskeisten suorituskykytekijöiden selitysvoima ei ole kovin riippuvainen markkinatilasta, mutta voittajien ja häviäjien ominaisuuksien ja markkinoiden tilan välillä on selvä yhteys. Tulokset osoittavat, että Covid-19-periodilla on enemmän yhteisiä piirteitä finanssikriisin kuin talousbuumin kanssa.

ACKNOWLEDGEMENTS

First, I want to thank Professor Eero Pätäri for supervising this thesis and giving helpful feedback. I would also like to thank LUT University and Enklaavi ry for all the new friends and good memories that I have made during the last 5 years. Last but certainly not least, I want to thank my girlfriend, family, and friends for supporting me during this journey. This Master's thesis is dedicated to all of you.

Sincerely,

Otto Eurola

28.02.2022, Espoo

Abbreviations:

ASEW = Market returns calculated with all stocks from Eikon during the time-period by equal weighting.

ASMW = Market returns calculated with all stocks from Eikon during the time-period by value weighting.

SEW = Market returns calculated from all Eikon stocks with no missing data by equal weighting.

SMW = Market returns calculated from all Eikon stocks with no missing data by value weighting.

PN = Market returns is set to 0% to compare stocks with positive and negative returns.

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1. Introduction

Despite the global crisis of the Covid-19 pandemic, the stock market has soared to new all-time highs. (Nasdaq, 2022) Multiple actions of fiscal and monetary policy are thought to be the main reasons for the seeming disconnect between the stock market and the real economy. (Brookings, 2021) To understand the state of the market we are currently in, we must look deeper, into the characteristics of the companies that are thriving and the ones that are not. By comparing the Covid-19 period to periods of varying market states in the 21st century, we can gain new insights on the state of the current market. Based on the characteristics of winners and losers of Covid-19, does it resemble a boom more than a crisis? And what are the key drivers of companies' performance during the Covid-19 pandemic?

1.1 Background of the research

The global Covid-19 pandemic has had devastating effects on multiple industries. Millions of people have lost their lives and millions more lost their sources of income. (World Health Organisation, 2022) (Pew Research Center, 2021) The stock market experienced a brief shock in March of 2020, but quickly proceeded to reach all-time high levels. (Nasdaq, 2021) Multiple factors contributed to this development. The loose monetary policy of the central banks kept interest rates low and made investing in the stock market a more attractive option. In March 2020 the Fed also announced a series of measures to help support the economy and the markets, which increased market confidence. (Brookings, 2021) The fiscal policy of the US Congress was also a contributing factor as they pumped trillions of dollars into the economy by passing multiple relief bills and thus increased the disposable income of households. (Congressional Research Service, 2021) There has also been a myriad of examples of irrational exuberance among investors, such as the fanatic approach of retail investors towards “meme stocks” and towards the volatile cryptocurrency market. (Financial Times, 2021)

On the surface, the trend of the stock market seems to be very disconnected from the real economy. To understand the current state of the market better, we must look at the companies of which the market consists of. Identifying the key drivers of stock performance and their relation to various market states allows us to compare the current market state to previous periods and gain insights on what is driving the current performance in the markets. The goal is to find out does the Covid-19 period resemble the financial crisis more than the preceding period of economic expansion, based on the characteristics of the stocks that are thriving and the ones that are not.

1.2 Research objectives

This research aims to gain new insights on key performance drivers of companies' stocks in varying stock market states. The goal of the research is to find what are the key performance drivers in the 5 examined sub-periods and to what extent these key drivers are dependent on these market states. The sub-periods are: The ICT bubble (04/2000 – 08/2002), the economic boom (09/2002 – 10/2007), the financial crisis (11/2007 – 02/2009), the recovery period (03/2009 – 01/2020) and the Covid-19 pandemic (02/2020 – 10/2021). The goal is also to find out what characteristics are common among winners and losers in different market states. After identifying the key performance drivers that are characteristic for recessions or periods of economic expansion and the characteristics of winners and losers in various market states, the gained insight will be used to answer the question: Does the Covid-19 pandemic resemble a recession, or an economic boom based on the characteristics and key performance drivers of the winners and losers of the Covid-19 subperiod? This topic is important to study right now to better understand the current state of the market. Despite the devastating effects of the Covid-19 pandemic on multiple industries, the monetary policy of central banks has allowed the subperiod of Covid-19 to be a period of irrational exuberance. The juxtaposition of shut down economies and aggressively growing markets is an interesting object to study, and by focusing the analysis on the key drivers and characteristics of the winners and losers of the Covid-19 period, it is possible to gain new insights on what type of a market state is underlying below the overheated market.

This research focuses on the companies listed in The New York Stock Exchange (NYSE), NYSE American (formerly known as AMEX) and the Nasdaq stock market, which includes the Capital Market, the Global Market and the Global Select Market. The full sample period is from April 2000 to October 2021. The methodology includes conducting Welch's t-tests to compare the means of variables in the winner- and loser-portfolios in different subperiods, normalizing the variables and conducting cross-sectional regression analysis for different subperiods, to find out how much explanatory power different variables hold over the total returns in different time periods. The methodology also includes analysis of the characteristics of winners and losers, conducting the White test, utilizing the Huber-White standard errors in cross-sectional regressions, and analysing different sized fractiles of the data and different market returns to find out how sensitive the models are to changes in portfolio size.

Research questions:

Question 1: *“What have been the key performance drivers of stocks in NYSE, AMEX and NASDAQ between 2000-2021?”*

Question 2: *“What characteristics are specific to companies that have outperformed the market and companies that have underperformed the market?”*

Question 3: *“To what extent are these key drivers dependent on varying market states?”*

Question 4: *“How much of the total returns of companies are explained by the identified key drivers?”*

Question 5: *“Are the characteristics of companies in winner- and loser-portfolios similar in similar market states?”*

Question 6: *“Are the characteristics of companies in winner- and loser portfolios different in different market states?”*

Question 7: *“Based on the characteristics of winners and losers, is the Covid-19 period closer to the financial crisis, or the economic boom before the financial crisis?”*

Question 8: *“Does changing portfolio-size or market returns change the results significantly?”*

The structure of the thesis is relatively standard. After the introduction, the previous studies are discussed in the literature review. The next section then focuses on the data and methodology of the research and finally the results and conclusions are provided.

Previous research on anomalies has mostly focused on finding out whether anomalistic variables can forecast future returns. In this research, the main goal is to find out what are the anomalous drivers that are common for winners and losers, and to what extent are these key drivers dependent on the market states.

Limitations of this research include some missing data from the analysed companies, which has led to some companies being excluded from the tests, the relatively long time-periods that are studied, which can lead to some of the results not being very precise, as well as the variables that were chosen to be examined as potential key performance drivers being a relatively small set of all possible variables that could be researched.

2. Literature review

The 21st century so far, can be divided into subperiods based on the state of the markets. In this research, the identified subperiods are the ICT bubble, the economic boom, the financial crisis, the recovery period, and the Covid-19 period. The ICT bubble and the financial crisis are periods of economic downturn and the economic boom, the recovery period and the Covid-19 period are periods of economic growth. The Covid-19 subperiod started with a large shock, which was short-lived, and the market quickly rose to all time high levels. Based on the total market returns of the subperiod it has been the period of highest return by far during the 21st century.

The differences between the two identified subperiods of stock market downturn, the ICT bubble and the financial crisis, can partly be explained by the findings of Campbell, Giglio and Polk (2013) who discovered that these two market downturns had very different causes. The stock market downturn of the ICT bubble subperiod saw a large increase in the discount rates applied to profits by rational investors, while the financial crisis saw a decrease in rational expectations of future profits. According to their study the economic expansion of the economic boom -subperiod was driven by a mix of cash flows and discount rates. The boost in investor confidence that drove the growth of the US stock markets during the recovery period and the Covid-19 period was because of actions by the US congress and the Federal Reserve System. In September 2007, the Federal Reserve System lowered interest rates moderately, which provided support in calming the markets. (Federal Reserve, 2021) In October 2008 Congress approved a \$700 billion bank bailout, now known as the Troubled Asset Relief Program. (Congressional Budget Office, 2012, a) In February 2009, Congress passed the American Recovery and Reinvestment Act. The \$787 billion economic stimulus plan helped end the recession. It granted \$282 billion in tax cuts and \$505 billion for new projects. (Congressional Budget Office, 2012, b) In December 2020, the US congress passed a \$900 billion stimulus package and in March 2021, President Joe Biden signed a \$1.9 trillion Covid-19 relief package. (The White House, 2021) (US Department of Treasury, 2022)

2.1 Key performance drivers

There are several anomalies in previous literature that have been linked to abnormal returns. These anomalies will be the ones that are suspected of being the key performance drivers of stocks in this research. The size anomaly implies that returns of small firms are significantly larger than returns of larger firms. (Banz 1981) The leverage effect implies that there is a positive relation between leverage and average returns. (Bhandari 1988) In this research the leverage effect is split into financial and operating leverages. The value anomaly implies that average returns on U.S. stocks are positively related to the ratio of a firm's book value of common equity, to its market value. Average annual price-to-book ratios will be used as a proxy for this value measure. (Stattman 1980) The profitability anomaly implies that companies with robust operating profitability outperform companies with weak operating profitability. In this thesis the return on equity (ROE -%) is the metric used for this profitability proxy. (Fama & French, 2015) According to the investment anomaly, companies that invest conservatively outperform companies that invest aggressively. In this thesis, asset growth is employed as the metric for investment intensity. (Fama & French, 2015) The momentum anomaly implies that stocks have a tendency to show persistence in performance. Winners are more likely to keep winning and losers are more likely to keep losing. In this thesis, a 1-month lagged 12-month momentum is used. (Fama-French, 2012) The cash holdings effect implies that companies with excess cash have been reported to have higher stock returns than companies with low cash holdings. (Simutin 2010)

2.2 Dependence of the key performance drivers to varying market states

Many anomalies have been identified in earlier academic literature to outperform the market in the long run. These include the size effect (Banz 1981), the value anomaly (Stattman 1980), the leverage effect (Bhandari 1988), the profitability anomaly (Fama & French 2015), the investment anomaly (Fama & French 2015), the momentum anomaly (Fama & French, 2012) and the cash holdings effect (Simutin 2010). These anomalies are examined in this thesis as the key performance drivers to stock returns.

The dependence of some of these key performance drivers to varying market states has been researched in previous academic literature. Winkelmann, Suryanarayanan, Hentschel, and Varga (2013) claim that value stocks are less flexible to withstand economic downturns and shocks, and thus they are inherently riskier, especially in market states of economic downturn. This observation is supported by Campbell, Giglio, and Polk (2013), who agreed that value stocks perform better on average but worse during the downturns relative to the market. According to these findings, value stocks tend to outperform the market in economic growth state and underperform the market in economic downturns.

Similar findings have been made regarding the size-factor. Van Dijk (2011) found that portfolios of small-cap stocks are more sensitive to economic shocks in relation to large-cap portfolios, which means a higher risk and return for the small-cap companies. These findings are similar to Kilbert and Subramanians (2010) who showed that small-cap stocks performed badly and underperformed large-cap stocks during the financial crisis. Despite the poor performance during the financial crisis, they pointed out that after the crisis, small-cap stocks rebounded faster than the large-cap stocks. These earlier findings indicate that the small-cap companies can outperform the market in economic expansions but underperform the market in economic downturns.

The momentum anomaly has also been studied in previous academic literature. Imran, Wong, and Ismail (2020) researched the viability of momentum strategies, in 40 different countries globally between the years 1996 and 2018. Their results indicate that the momentum effect can be identified in 90% of the chosen countries of which 52.5% produced positive momentum, whereas 37.5% produced negative momentum. Daniel and Moskowitz (2016) researched the performance of momentum strategies in market crashes and the results show that the returns of the momentum strategy were the worst during the time when the market downturn was turning back up. Their results indicate that after the financial crisis during the years 2009 - 2010, the stocks previously identified as winners underperformed relative to the market portfolio. The results show that during the financial crisis turning point,

after the U.S. stock market bottomed in March 2009, the loser stocks outperformed the winner stocks by 149%.

The market state dependence of the profitability anomaly and the momentum anomaly were discussed by Liang, Tang and Xu (2019), who concluded that the profits of the momentum/profitability strategies were present in periods of market downturn. Their findings were consistent with high-uncertainty stocks' greater vulnerability to market states of economic downturn documented in previous academic literature. (Liang, Tang, Xu, 2019)

The changes in the performance of factor-investing strategies are not always a direct consequence of a change in the market state, as shown by David Blitz (2021): During the period 2018-2020 quantitative stock selection models generally underperformed, since the common factors, such as the value factor, underperformed. Blitz (2021) also briefly goes through other significant periods in recent history when the factor models have underperformed. In these periods the change in market state has not coincided with the change in the performance of the strategies.

3. Data and methodology

This chapter focuses on the data that is used in this research and the methodology of the research. The empiric part of the thesis is conducted as quantitative research. The data is acquired from the Refinitiv Eikon -database, and the empirical analysis is done in MS Excel, MATLAB and Stata.

3.1 Data

The sample includes 13 variables for 1424 companies for 5 different subperiods. The sample includes companies from the New York Stock Exchange (NYSE), NYSE American (AMEX) and the Nasdaq stock market from the years 2000-2021. This sample does not include all U.S. Compustat and CSRP companies, just all companies that have their data available in Eikon. Total amount of observations is 99680. The variables include the name of the company, exchange name, industry, sector, total returns, market capitalization, price-to-book, asset growth, return on equity -%, operating leverage, financial leverage, cash holdings and 12-month momentum 1-month lagged. The momentum variable and the total returns are calculated from monthly returns and the rest of the variables are calculated from yearly data. The variables represent the average values of the subperiods, and they are calculated independently for each subperiod. Companies with missing values are excluded from the research. The total number of examined stocks in different subperiods is 961 for the ICT bubble, 954 for the economic boom, 1008 for the financial crisis, 978 for the recovery period and 1016 for the Covid-19. The data also includes the returns of the market portfolio calculated in five different ways.

3.1.1 Variables

The variables are calculated separately for each subperiod from the Refinitiv Eikon data. The total returns -variable is calculated as total returns for the given subperiod. It is calculated from monthly returns. The size-variable represents the market capitalization of the company,

total amount of outstanding shares times the market price of one share. It is calculated as an average value of yearly data for each subperiod. The value-variable is the price-to-book ratio of the companies. It is calculated as market price per share divided by book value per share. The P/B values are calculated for every year and then mean values are calculated from these yearly values for every subperiod. The market value -based variables are calculated as yearly mean values from monthly data and the balance sheet -based variables are based on the most recent financial statements in June of each year. The investment-variable is the growth of total assets for the subperiod. It is measured as the total change in the reported total assets of the companies during each subperiod. The profitability-variable is return on equity -%. It is calculated as net income divided by shareholders' equity. It is an average value of yearly values for the subperiod. The operating leverage -variable is calculated as net fixed assets divided by total assets. It is an average of yearly values for the subperiod. The financial leverage -variable is calculated as total liabilities divided by sales. It is an average value of yearly values. The cash holdings -variable is calculated as average cash & cash equivalents for the subperiod, calculated as an average from yearly data. The momentum-variable is calculated as 1-month lagged 12-month cumulative returns before the beginning of the given subperiod. Other variables of the model include: company name, name of the exchange, sector and industry. The descriptive statistics of the data are presented in the Tables 1-5:

ICT BUBBLE 04/2000 – 08/2002	Mean	Min	Max	Std Dev
TOTAL RETURNS	0,059	-0,412	2,994	0,357
SIZE	\$5,880B	\$2,570M	\$369,0B	\$26,402B
VALUE	3,610	-31,009	99,949	6,638
INVESTMENT	0,179	-0,645	27,328	0,943
PROFITABILITY	2,867	-3.234,940	1.159,699	134,032
OPERATING LEVERAGE	0,463	-0,250	2,600	0,284
FINANCIAL LEVERAGE	1,151	0,001	40,016	2,172
CASH HOLDINGS	\$186,338M	\$0	\$8,394B	\$636,327M
MOMENTUM	-0,041	-0,969	2,294	0,417

Table 1: Descriptive statistics for the variables in the ICT bubble -subperiod

ECONOMIC BOOM 09/2002 – 10/2007	Mean	Min	Max	Std Dev
TOTAL RETURNS	0,538	-0,157	25,669	1,236
SIZE	\$6,796B	\$3,111M	\$344,2B	\$25,411B
VALUE	4,503	-42,583	813,769	28,840
INVESTMENT	0,118	-0,227	2,564	0,160
PROFITABILITY	11,921	-2.653,148	2.413,541	165,409
OPERATING LEVERAGE	0,453	-0,362	1,947	0,270
FINANCIAL LEVERAGE	1,697	0,006	436,104	14,327
CASH HOLDINGS	\$339,767M	\$54.500	\$31,172B	\$1,402B
MOMENTUM	0,147	-0,953	6,793	0,594

Table 2: Descriptive statistics for the variables in the economic boom -subperiod

FINANCIAL CRISIS 11/2007 – 02/2009	Mean	Min	Max	Std Dev
TOTAL RETURNS	-0,392	-0,779	0,943	0,214
SIZE	\$7,182B	\$6,636M	\$411,9B	\$25,440B
VALUE	3,716	-170,805	566,649	21,639
INVESTMENT	0,105	-0,352	2,978	0,231
PROFITABILITY	23,215	-1.442,177	6.613,333	310,614
OPERATING LEVERAGE	0,441	-0,420	1,649	0,267
FINANCIAL LEVERAGE	1,942	0,001	316,609	13,391
CASH HOLDINGS	\$447,746M	\$48.740	\$37,870B	\$1,957B
MOMENTUM	0,123	-0,829	3,288	0,361

Table 3: Descriptive statistics for the variables in the financial crisis -subperiod

RECOVERY PERIOD 03/2009 – 01/2020	Mean	Min	Max	Std Dev
TOTAL RETURNS	0,388	-0,092	22,307	0,894
SIZE	\$12,922B	\$4,818M	\$718B	\$44,239B
VALUE	21,347	-215,634	15.864,558	509,133
INVESTMENT	0,080	-0,186	1,316	0,104
PROFITABILITY	28,498	-3.479,210	12.906,170	488,608
OPERATING LEVERAGE	0,447	0	1,302	0,253
FINANCIAL LEVERAGE	1,460	0	168,670	6,561
CASH HOLDINGS	\$693,830M	\$21293	\$62,290B	\$2,811B
MOMENTUM	-0,339	-0,968	1,908	0,299

Table 4: Descriptive statistics for the variables in the recovery -subperiod

COVID-19 02/2020 – 10/2021	Mean	Min	Max	Std Dev
TOTAL RETURNS	0,709	-0,428	37,759	1,560
SIZE	\$23,749B	\$9,660M	\$2.228B	\$119B
VALUE	6,484	-715,507	731,595	50,110
INVESTMENT	0,118	-0,430	8,686	0,406
PROFITABILITY	26,037	-19.187,375	16.093,372	927,072
OPERATING LEVERAGE	0,460	0	1,807	0,256
FINANCIAL LEVERAGE	1,555	-26,096	151,146	5,378
CASH HOLDINGS	\$941,381M	0	\$56,082B	\$3,255B
MOMENTUM	0,104	-0,989	2,640	0,354

Table 5: Descriptive statistics for the variables in the Covid-19 -subperiod

3.2 Methodology

In the first step of the methodology, the required data is downloaded from the Refinitiv Eikon -database. The data is imported into Excel, and it is cleaned and sorted for the requirements of the research. The variables for different subperiods are calculated as averages or single values from monthly and yearly data. The values of the variables are then divided into tables that represent each subperiod.

The tables are then imported into MATLAB, where an algorithm was developed to clean and process the data and to conduct various tests. The algorithm allows to choose a subperiod and divide the data of the subperiod into a winner-portfolio and a loser-portfolio based on whether the companies over- or underperformed the market portfolio of the given subperiod. The market returns are calculated in five different ways to test if it has effect on the results of the tests. The market returns are calculated in the following ways: By equal weighting and including all stocks with monthly returns available, by value weighting and including all stocks with monthly returns available, by equal weighting and including all stocks with all data available, by value weighting including all stocks with all data available and positive

returns vs negative returns. Once the data is divided into portfolios based on the relation to market returns, the algorithm runs the Welch's t-test for all possible fractile sizes of the portfolio from 30 stocks to the threshold, calculated on the basis of the market returns and the amount of stocks in the compared portfolios, and saves the results of the t-tests into matrices. This is done in MATLAB with the algorithm that utilizes nested loops and logical indexing. The t-tests are done in two ways: First, winners are compared to losers in the same subperiod to find the key drivers of performance in each subperiod, second winners (losers) are compared winners (losers) in different subperiods. The goal is to identify the characteristics of winners and losers in different market states (subperiods) and to gain insight on how much the key drivers are dependent on different market states. When the stocks are divided into winners and losers the threshold is the number of stocks in the smaller of these two portfolios. This means that the chosen market return limits the maximum possible size for the fractiles of the winner- and loser-portfolios. The minimum size of the studied portfolios was chosen to be 30 stocks, so that the results would be significant. The effect of changing the market returns and the fractile-size can then be examined from the resulting matrices. The algorithm is used for all subperiods. The characteristic of winners and losers are also compared by examining the mean values of the 9 variables in all subperiods for the winner and loser portfolios.

3.2.1 Welch's t-test

The goal of the Welch's t-test is to test the hypothesis that two populations have equal means. The test is used when the number of samples in the two groups is different and the variance of the two groups is also not equal. (Welch, 1947) The test is also known as the Unequal variance t-test. This test is used in this study to find differences and similarities in the characteristics of the companies in the studied portfolios. The Welch's t-test is calculated as follows:

$$t = \frac{m_A - m_B}{\sqrt{\frac{S_A^2}{n_A} + \frac{S_B^2}{n_B}}} \quad (1)$$

Where,

M_A and M_B = The average values of the sample sets

S_A and S_B = The standard deviations of the two groups.

N_A and N_B = The sample sizes of the two groups

- Null hypothesis (H_0): the two group means are identical ($m_A = m_B$)
- Alternative hypothesis (H_a): the two group means are different ($m_A \neq m_B$)

The independent samples t-test can be conducted by using the Student's t-test, which assumes the variances of different samples to be equal, or Welch's t-test which allows the variances to be unequal. Welch's t-test then results in fractional degrees of freedom compared to Student's t-test. The null hypothesis for Welch t-test is that the means of two independent groups are equal. (Datanovia, 2020) Unlike the Student's t-test, Welch's t-test does not use the pooled variance but allows the comparison of variances between two groups. The degrees of freedom need to be defined, before interpreting the results. The equation to calculate the degrees of freedom is as follows:

$$df = \left(\frac{S_A^2}{n_A} + \frac{S_B^2}{n_B} \right)^2 / \left(\frac{S_A^4}{n_A^2(n_A-1)} + \frac{S_B^4}{n_B^2(n_B-1)} \right) \quad (2)$$

Where,

S_A and S_B = The standard deviations of the two groups.

N_A and N_B = The sample sizes of the two groups

The t-statistic is compared to its critical value based on the t-table. If a t-statistic is greater than its corresponding critical value, the null hypothesis is rejected. To get reliable results, certain assumptions need to be fulfilled. The two samples under examination are required to be drawn from a normal population with means M_A and M_B and variances S^2_A and S^2_B . The two samples also need to be independent. (Redwoods, 2020)

3.2.2. Cross-sectional regressions

After running the algorithm and analysing results of the Welch's t-tests, the next step is conducting cross-sectional regressions for all subperiods. The goal of the cross-sectional regressions is to gain insights into the explanatory power of all the variables on the total returns of companies' stocks in different subperiods. The variables are normalized by using Z-score normalization so that the variables have equal potential for explanatory power. After normalizing the variables, the data is not divided into portfolios, as this test is conducted for all data. The cross-sectional regression is calculated for all subperiods separately and the results are compared to find out how the explanatory power of different variables varies in different market states. The regressions are conducted as ordinary least squares -regressions (OLS).

3.2.3 Ordinary least squares

The initial cross-sectional regressions are conducted as ordinary least squares regressions. The goal of the Ordinary least squares is to get results, that will be used as inputs to the White test, where the standard errors will be tested for heteroscedasticity. Hill, Griffiths and Lim (2018) state that the general form of the OLS equation can be written as:

$$y_i = \beta_1 + \beta_2 x_{i2} + \beta_3 x_{i3} + \beta_n x_{in} + \varepsilon_i \quad (3)$$

Where,

y_i = dependent variable

β_1 = intercept

β_{2-k} = independent variables

x_{i2-in} = constant terms

ε_i = error term

Hill, Griffiths and Lim (2018) state that the linear regression has six assumptions on the components in the equation for completing the specification of the linear regression model:

1. Observations form the dependent variable's values with population relationship of $y_i = \beta_1 + \beta_2 x_{i2} + \beta_3 x_{i3} + \beta_n x_{in} + \varepsilon_i$
2. The random error term ε_i is conditionally expected to equal zero with all observations.
3. The variance of the error is a constant, $\text{var}(\varepsilon_i) = \sigma^2$
4. The covariance of any different error terms equals zero, $\text{cov}(\varepsilon_i, \varepsilon_j) = 0$
5. No exact linear relationship exists between the independent variables.
6. Residuals of the model are normally distributed.

Based on the Gauss-Markov theorem, under the first five assumptions of the list, the ordinary least squares estimator has the smallest variance of all linear and unbiased estimators. The OLS method used in this study fits a line to the data by minimizing the sum of the squares that are calculated from every point's vertical distance to the fitted line. The squaring of the values prevents the positive distances from the line from being cancelled by the negative distances. (Hill, Griffiths & Lim 2018, 61, 72)

3.2.4. The White test

After the OLS regressions are complete, the residuals of the models are analysed for heteroscedasticity in the residuals with the White test. The first step of the White test is to run the OLS regression and keep the standard errors. The next step is the auxiliary regression where e^2 is regressed on all explanatory variables, their squares and their cross-products. The R-squared value from this regression is retained for later use. The last step is to compute the LM statistic. (White 1980)

3.2.5 Huber-White robust standard errors

After analysing the results of the White test, the OLS regressions are conducted with Huber-White robust standard errors to get reliable results. When using the heteroscedasticity-consistent standard errors, the Ordinary Least Squares method is the best linear unbiased estimator. The Huber-White robust standard errors were acquired and used in Stata. (Huber 1967)

4. Results

In this chapter the results of the empirical analysis are presented. First the characteristics of winners and losers are examined. Then the market returns are presented, along with plots and tables of the results of conducting Welch's t-tests with varying market returns, fractile sizes and subperiods. After that the results of the initial cross-sectional OLS regressions are presented. Then, the results of the White test are shown. Finally, the results of the OLS with the Huber-White robust standard errors are provided.

4.1. Characteristics of winners and losers

The mean values of all variables in the winner and loser portfolios in all subperiods are compared. The portfolio split is conducted by using all 5 different market returns. The mean total returns are obviously higher in winners than losers. The mean values of the other 8 variables for the winner and loser portfolios in all subperiods show that the characteristics of winners and losers vary in different market states. The only exception is financial leverage, which is lower in winners than losers in all subperiods. The characteristics change in different subperiods but the relationship between the characteristics and market states does not hold in any of the variables except operating leverage. When comparing subperiods to each other the only subperiod that does not have varying results for different variables is the Covid-19 subperiod. In the Covid-19 subperiod, all variables have lower mean values in the winner portfolio than the loser portfolio. In general, the winner portfolio has more mean values of variables that are lower than the values of the loser portfolio.

4.2 Market returns

The ICT bubble and financial crisis -subperiods are the subperiods of economic downturn. The economic boom and the recovery period are the subperiods of economic growth. The Covid-19 subperiod had the overall highest market returns and the financial crisis period had

the lowest market returns overall. The market returns that are used in this research are shown in Table 6:

MARKET RETURNS	ICT BUBBLE	ECONOMIC BOOM	FINANCIAL CRISIS	RECOVERY	COVID-19
All stocks, equal weight	0,081	0,478	-0,391	0,349	0,711
All stocks, market weight	-0,044	0,300	-0,363	0,492	0,479
Sample stocks, equal weight	0,059	0,538	-0,392	0,388	0,709
Sample stocks, market weight	-0,061	0,330	-0,329	0,524	0,474
Positive returns vs negative returns	0	0	0	0	0

Table 6: Market returns calculated in 5 different ways for all subperiods

4.3 Comparing winner- and loser portfolios in the same subperiod

When examining the results of the Welch's t-tests, conducted at a 5% risk level, for all possible fractile sizes, the only subperiod where most of the characteristics of winners and losers are consistently significantly different is the ICT bubble. The smallest possible fractile size in this study is 30 stocks, so that the results are meaningful. Somewhat counterintuitively, decreasing the size of the fractiles, to only include the stocks with most extreme returns, often tends to increase the number of variables with similarity between the winner and loser portfolios. This unexpected effect is absent when comparing winners to winners or losers to losers in different periods. Excluding the tests using positive vs negative market returns, that result in very low thresholds, all subperiods have some fractile size with all market returns that has more results of $h_0 = \text{rejected}$ than results of $h_0 = \text{accepted}$, but most of the results show similarity between winners and losers in the same subperiod. The distribution tables of amount of statistically different variables give additional information on which variables are similar or different between winners and losers in different subperiods. The characteristics that are most often different with winners and losers in the same subperiod are in order: total returns, size, investment, profitability, operating leverage and momentum. The characteristics with most similarity include value, financial leverage and cash holdings. Figures for amount of statistically different variables for all fractile sizes

are shown below. Different colours of the plot line represent portfolios divided into winners and losers with different market returns:

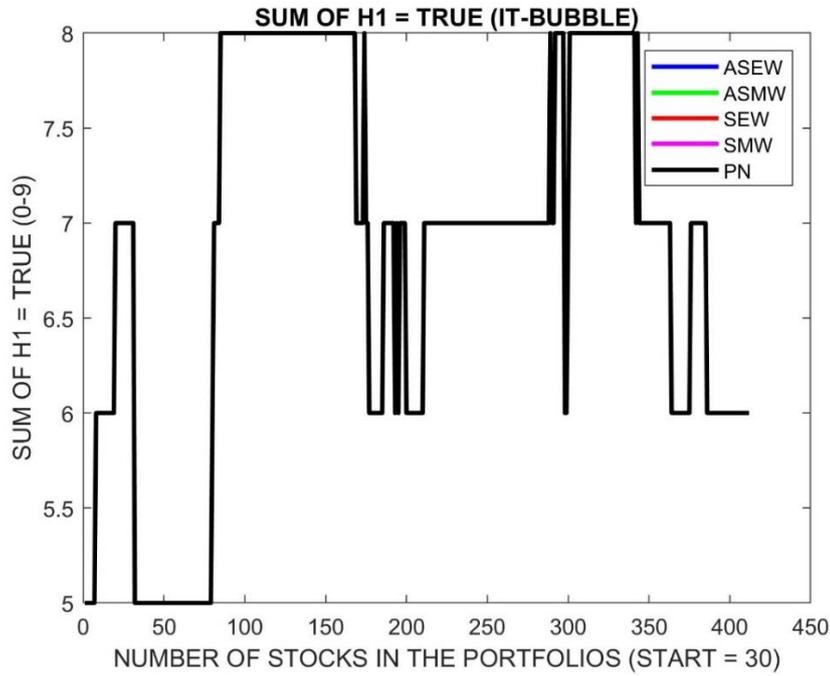


Figure 1: Amounts of variables with statistically different values for the ICT bubble -subperiod

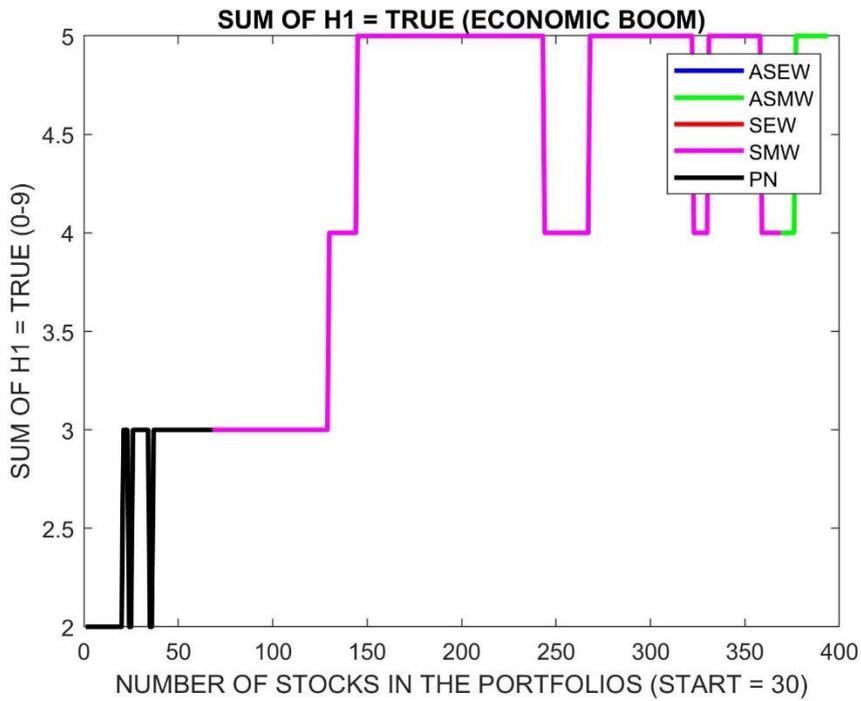


Figure 2: Amounts of variables with statistically different values for the economic boom -subperiod

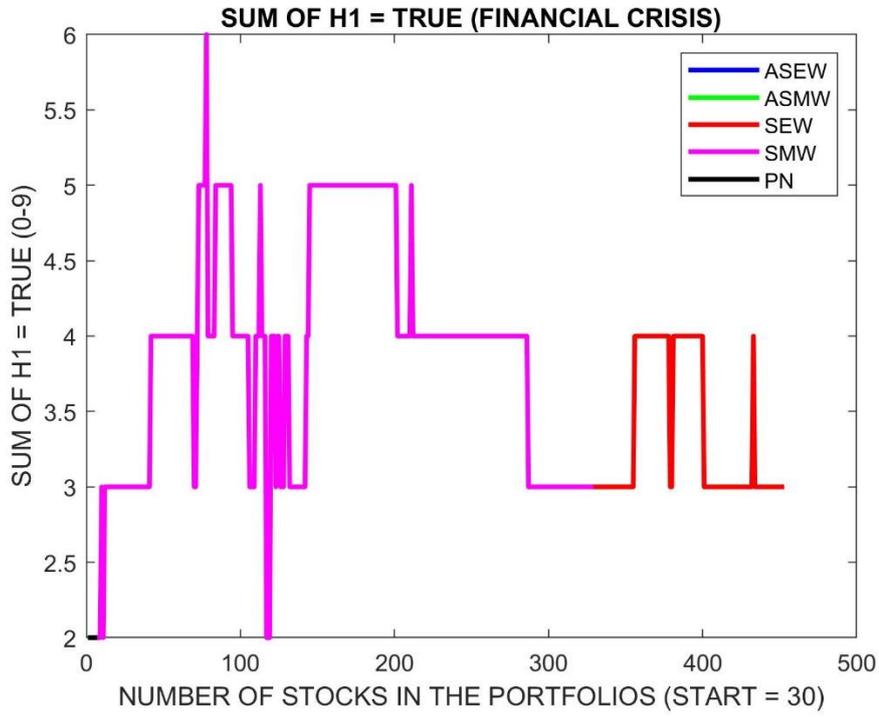


Figure 3: Amounts of variables with statistically different values for the financial crisis -subperiod

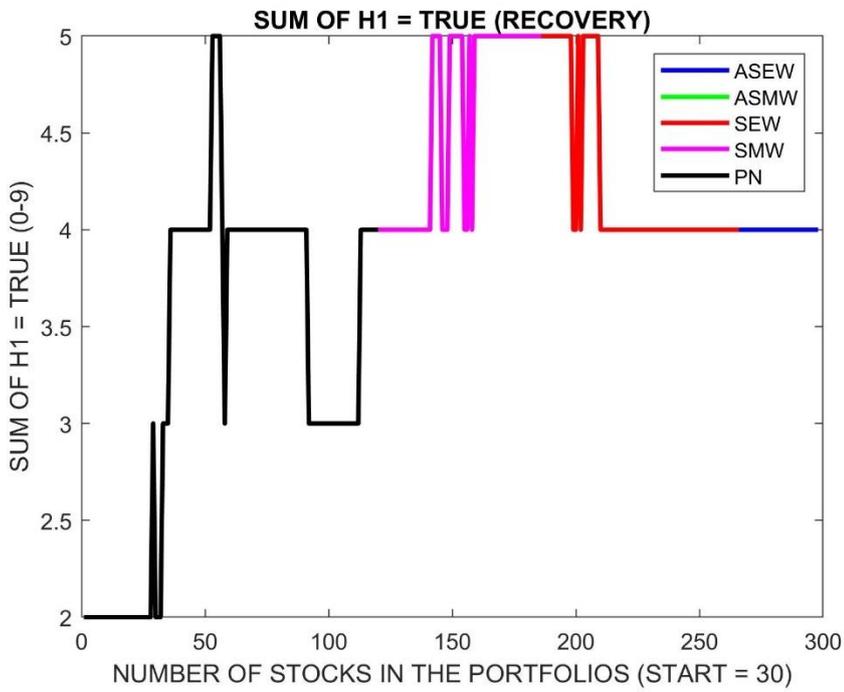


Figure 4: Amounts of variables with statistically different values for the recovery -subperiod

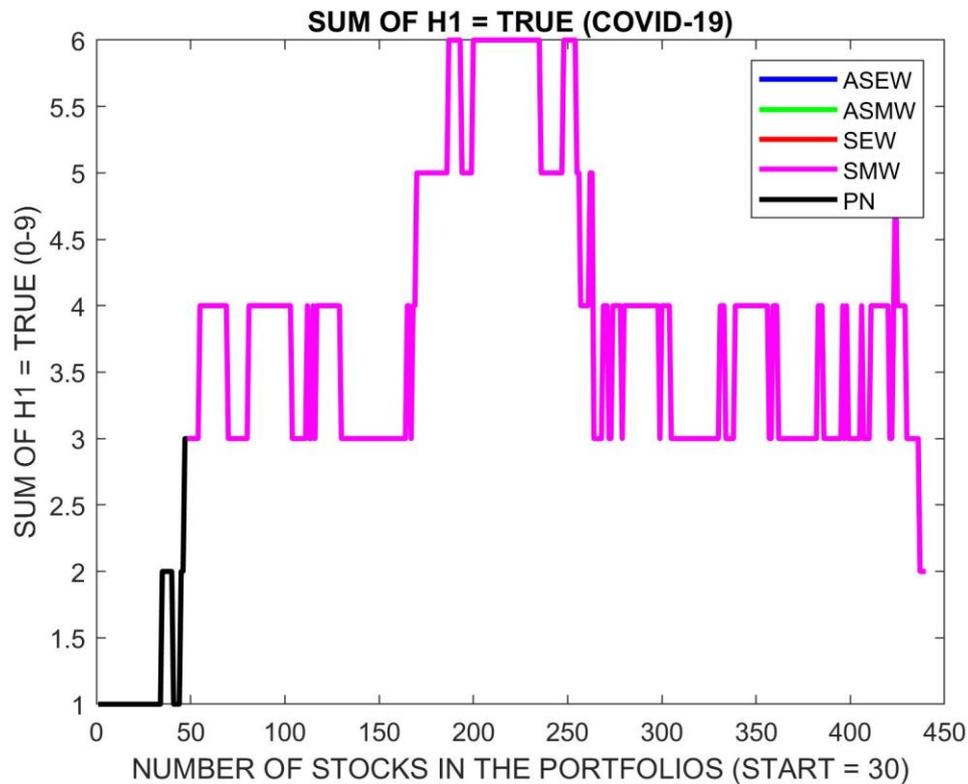


Figure 5: Amounts of variables with statistically different values for the Covid-19 -subperiod

The Figures 1-5 illustrate how sensitive the model is to changes in the size of the portfolios, as well as the overall trend that similarity in characteristics is inversely proportional to the size of the portfolios. Tables are presented next to get a better understanding of the overall results of the model. Table 7 shows the maximum amount of $h_0 =$ rejected, when testing for all possible fractile sizes, all possible market returns and all subperiods. Table 8 shows the mean amount of $h_0 =$ rejected, when testing for all possible fractile sizes, all possible market returns and all subperiods. Tables 9-13 show in detail the distributions of statistically different variables for all subperiods. In the distribution tables, 100% means that the variables of the winner and loser portfolios were statistically different with all possible portfolio-sizes. 0% means that the variables were not statistically different with any possible portfolio-size.

MAX NUMBER OF H0 = REJECTED	ASEW	ASMW	SEW	SMW	PN	MAX VALUE
ICT BUBBLE	8	8	8	8	8	9
ECONOMIC BOOM	5	5	5	5	3	9
FINANCIAL CRISIS	6	6	6	6	2	9
RECOVERY PERIOD	5	5	5	5	5	9
COVID-19	6	6	6	6	3	9

Table 7: Maximum amount of statistically different variables for all subperiods

MEAN NUMBER OF H0 = REJECTED	ASEW	ASMW	SEW	SMW	PN	MAX VALUE
ICT BUBBLE	6,964	6,963	6,891	6,920	6,874	9
ECONOMIC BOOM	3,757	5	3,612	4,079	2,647	9
FINANCIAL CRISIS	3,729	3,820	3,726	3,866	2	9
RECOVERY PERIOD	3,916	3,827	3,906	3,758	3,300	9
COVID-19	3,768	3,648	3,766	3,641	1,250	9

Table 8: Mean amount of statistically different variables for all subperiods

ICT BUBBLE					
DISTRIBUTION OF H0 = REJECTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	100 %	100 %	100 %	100 %	100 %
SIZE	71 %	70 %	74 %	68 %	75 %
VALUE	100 %	100 %	92 %	100 %	91 %
INVESTMENT	17 %	18 %	15 %	15 %	15 %
PROFITABILITY	99 %	99 %	99 %	99 %	99 %
OPERATING LEVERAGE	77 %	77 %	80 %	75 %	80 %
FINANCIAL LEVERAGE	47 %	49 %	42 %	52 %	42 %
CASH HOLDINGS	85 %	84 %	86 %	83 %	86 %
MOMENTUM	100 %	100 %	100 %	100 %	100 %

Table 9: Distribution of statistically different variables in the ICT bubble -subperiod

ECONOMIC BOOM					
DISTRIBUTION OF H0 = REJECTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	100 %	100 %	100 %	100 %	100 %
SIZE	40 %	57 %	33 %	56 %	0 %
VALUE	0 %	0 %	0 %	0 %	0 %
INVESTMENT	100 %	100 %	100 %	100 %	100 %
PROFITABILITY	90 %	88 %	89 %	87 %	65 %
OPERATING LEVERAGE	46 %	67 %	40 %	65 %	0 %
FINANCIAL LEVERAGE	0 %	0 %	0 %	0 %	0 %
CASH HOLDINGS	0 %	0 %	0 %	0 %	0 %
MOMENTUM	0 %	0 %	0 %	0 %	0 %

Table 10: Distribution of statistically different variables in the economic boom -subperiod

FINANCIAL CRISIS					
DISTRIBUTION OF H0 = REJECTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	100 %	100 %	100 %	100 %	100 %
SIZE	88 %	86 %	88 %	83 %	0 %
VALUE	63 %	71 %	62 %	73 %	0 %
INVESTMENT	39 %	44 %	38 %	53 %	100 %
PROFITABILITY	80 %	78 %	80 %	73 %	0 %
OPERATING LEVERAGE	0 %	0 %	0 %	0 %	0 %
FINANCIAL LEVERAGE	0 %	0 %	0 %	0 %	0 %
CASH HOLDINGS	0 %	0 %	0 %	0 %	0 %
MOMENTUM	4 %	4 %	4 %	5 %	0 %

Table 11: Distribution of statistically different variables in the financial crisis -subperiod

RECOVERY PERIOD					
DISTRIBUTION OF H0 = REJECTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	100 %	100 %	100 %	100 %	100 %
SIZE	65 %	62 %	72 %	60 %	38 %
VALUE	100 %	0 %	0 %	0 %	0 %
INVESTMENT	6 %	100 %	100 %	100 %	100 %
PROFITABILITY	100 %	0 %	0 %	0 %	0 %
OPERATING LEVERAGE	72 %	83 %	87 %	82 %	72 %
FINANCIAL LEVERAGE	57 %	0 %	0 %	0 %	0 %
CASH HOLDINGS	81 %	2 %	2 %	2 %	0 %
MOMENTUM	100 %	36 %	30 %	32 %	20 %

Table 12: Distribution of statistically different variables in the recovery -subperiod

COVID-19					
DISTRIBUTION OF H0 = REJECTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	100 %	100 %	100 %	100 %	100 %
SIZE	49 %	31 %	49 %	30 %	21 %
VALUE	0 %	0 %	0 %	0 %	0 %
INVESTMENT	0 %	0 %	0 %	0 %	0 %
PROFITABILITY	0 %	0 %	0 %	0 %	0 %
OPERATING LEVERAGE	31 %	34 %	30 %	33 %	0 %
FINANCIAL LEVERAGE	47 %	65 %	47 %	65 %	0 %
CASH HOLDINGS	80 %	54 %	79 %	54 %	4 %
MOMENTUM	71 %	82 %	71 %	82 %	0 %

Table 13: Distribution of statistically different variables in the Covid-19 -subperiod

4.4 Comparing subperiods of economic expansion

In the periods of economic expansion, the losers of the subperiods have more in common with each other than the winners have with each other. The tables 26 and 27 at the end of chapter 4 show details of maximum and mean numbers of statistically similar variables in the compared subperiods. As expected, the variables are on average more similar in the compared similar subperiods when the portfolio size gets smaller. The results of the Welch's t-tests for winners of the economic boom and winners of the recovery period are shown in Table 14. The distribution of similarity among the variables, is shown in Figure 6. The results of the Welch's t-tests for losers of the economic boom and losers of the recovery period are shown in Table 15. The distribution of similarity among the variables is shown in Figure 7:

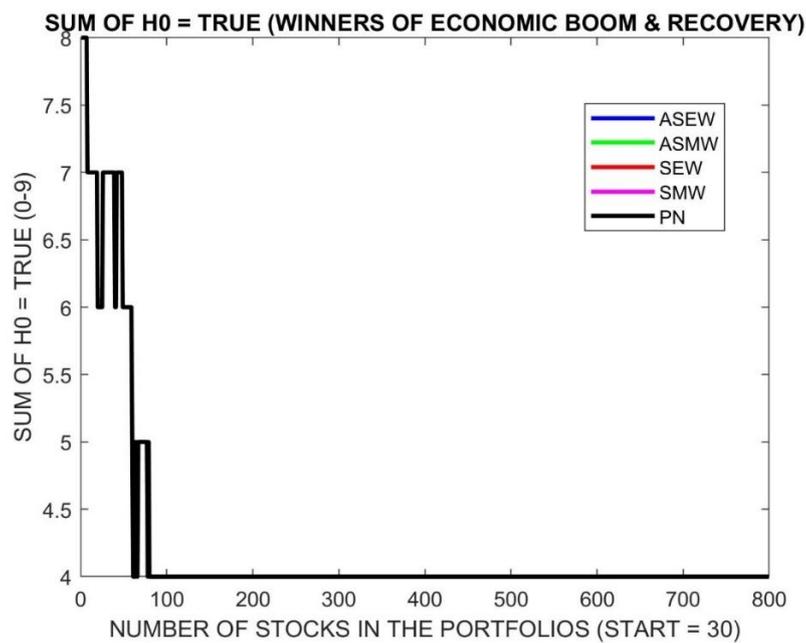


Figure 6: Amount of statistically similar variables for all portfolio sizes for winners of the economic boom & the recovery period

WINNERS OF ECONOMIC BOOM & RECOVERY					
DISTRIBUTION OF H0 = ACCEPTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	3 %	4 %	3 %	4 %	1 %
SIZE	25 %	30 %	28 %	32 %	8 %
VALUE	97 %	97 %	97 %	97 %	99 %
INVESTMENT	31 %	37 %	34 %	39 %	9 %
PROFITABILITY	100 %	100 %	100 %	100 %	100 %
OPERATING LEVERAGE	99 %	99 %	99 %	99 %	100 %
FINANCIAL LEVERAGE	100 %	100 %	100 %	100 %	100 %
CASH HOLDINGS	20 %	24 %	22 %	26 %	6 %
MOMENTUM	0 %	0 %	0 %	0 %	0 %

Table 14: Distribution of statistically similar variables for winners of the economic boom & the recovery period

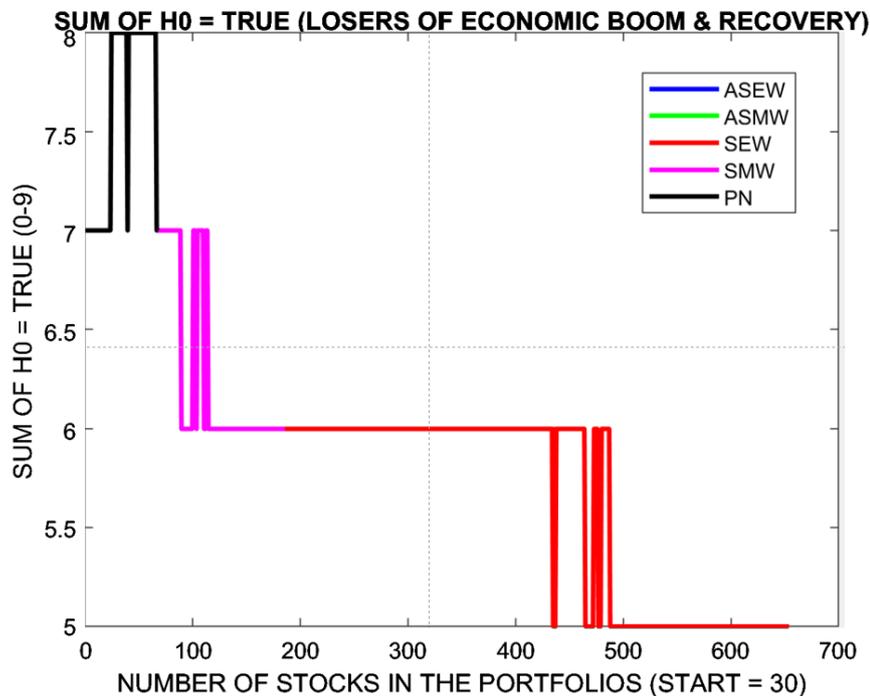


Figure 7: Amount of statistically similar variables for all portfolio sizes for losers of the economic boom & the recovery period

LOSERS OF ECONOMIC BOOM & RECOVERY PERIOD					
DISTRIBUTION OF H0 = ACCEPTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	7 %	21 %	6 %	23 %	62 %
SIZE	100 %	100 %	100 %	100 %	100 %
VALUE	100 %	100 %	100 %	100 %	100 %
INVESTMENT	16 %	50 %	15 %	53 %	99 %
PROFITABILITY	100 %	100 %	100 %	100 %	100 %
OPERATING LEVERAGE	100 %	100 %	100 %	100 %	100 %
FINANCIAL LEVERAGE	100 %	100 %	100 %	100 %	100 %
CASH HOLDINGS	76 %	100 %	72 %	100 %	100 %
MOMENTUM	0 %	0 %	0 %	0 %	0 %

Table 15: Distribution of statistically similar variables for losers of the economic boom & the recovery period

4.5 Comparing subperiods of economic downturn

When the subperiods of economic downturn are compared, the results show that in economic downturns, the winners of the subperiods have on average more in common with winners of other periods of economic downturn than the losers have in common with losers in other periods of economic downturn. Tables 26 and 27 show details of maximum and mean number of statistically similar variables. Among the winners, variables are more similar in the compared subperiods when the portfolio-size gets smaller. Among the losers, the effect is similar with fractile size under 400 stocks, but there is a rise in the number of statistically similar variables at the largest fractile sizes. This is the only instance of this sudden rise in similarity at the larger fractile sizes when comparing subperiods to each other. The results of the Welch's t-tests for winners of the ICT bubble and winners of the financial crisis are shown in table 16. The distribution of similarity among the variables of winners, can be seen from Figure 8. The results of the Welch's t-tests for losers of the ICT bubble and losers of the financial crisis are shown in Table 17. The distribution of similarity among the variables of losers, can be seen from Figure 9:

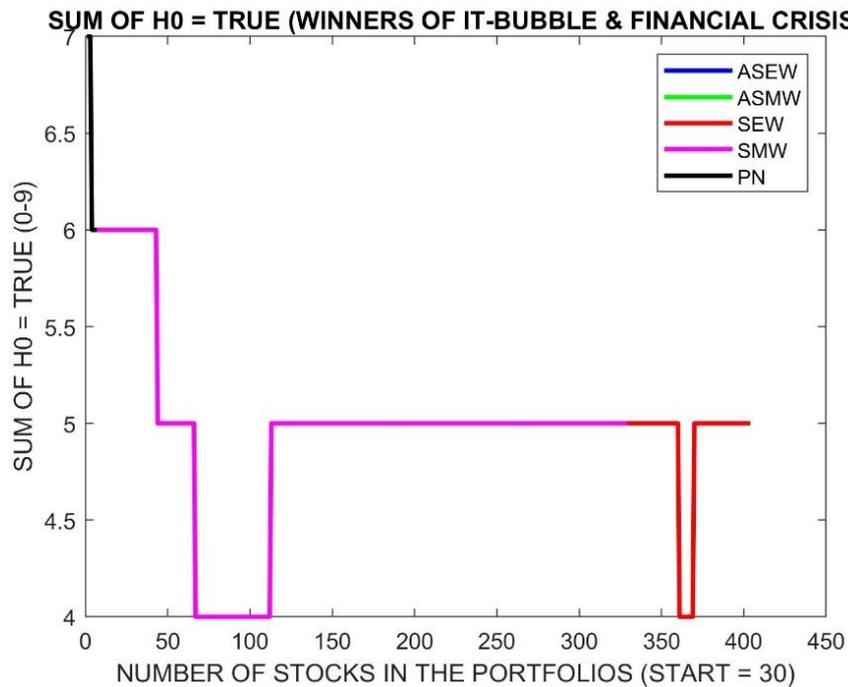


Figure 8: Amount of statistically similar variables for all portfolio sizes for winners of the ICT bubble & the financial crisis

WINNERS OF ICT BUBBLE & FINANCIAL CRISIS					
DISTRIBUTION OF H0 = ACCEPTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	0 %	0 %	0 %	0 %	0 %
SIZE	12 %	11 %	11 %	13 %	100 %
VALUE	100 %	100 %	100 %	100 %	100 %
INVESTMENT	100 %	100 %	100 %	100 %	100 %
PROFITABILITY	100 %	100 %	100 %	100 %	100 %
OPERATING LEVERAGE	69 %	63 %	62 %	67 %	43 %
FINANCIAL LEVERAGE	100 %	100 %	100 %	100 %	100 %
CASH HOLDINGS	18 %	17 %	16 %	20 %	100 %
MOMENTUM	0 %	8 %	9 %	0 %	0 %

Table 16: Distribution of statistically similar variables for winners of the ICT bubble & the financial crisis

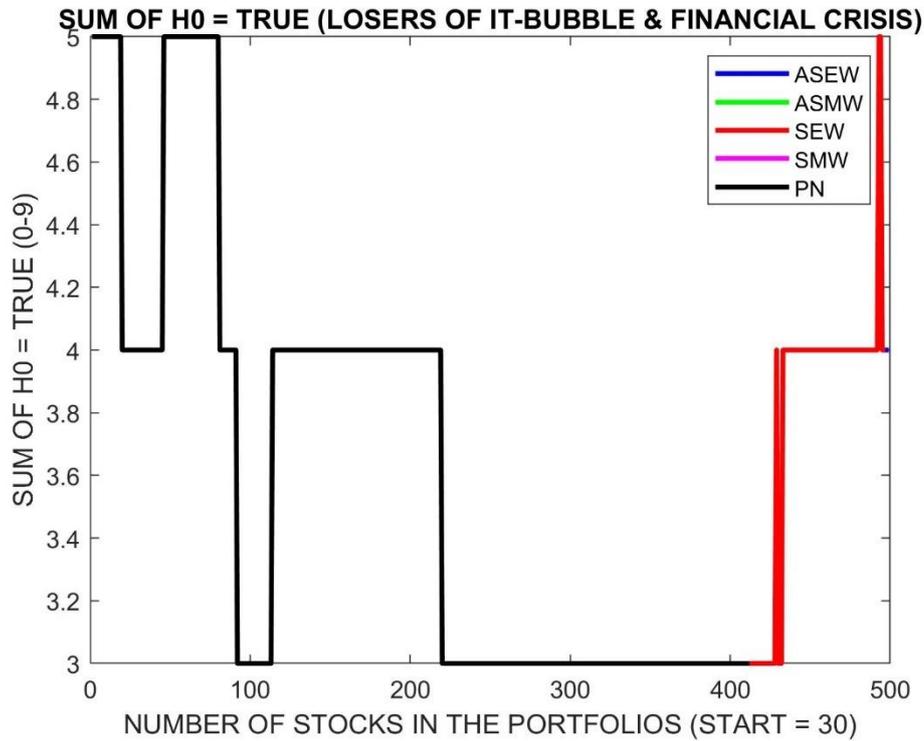


Figure 9: Amount of statistically similar variables for all portfolio sizes for losers of the ICT bubble & the financial crisis

LOSERS OF ICT BUBBLE & FINANCIAL CRISIS					
DISTRIBUTION OF H0 = ACCEPTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	0 %	0 %	0 %	0 %	0 %
SIZE	32 %	46 %	33 %	49 %	39 %
VALUE	0 %	0 %	0 %	0 %	0 %
INVESTMENT	18 %	26 %	18 %	28 %	22 %
PROFITABILITY	100 %	100 %	100 %	100 %	100 %
OPERATING LEVERAGE	14 %	0 %	13 %	0 %	0 %
FINANCIAL LEVERAGE	100 %	100 %	100 %	100 %	100 %
CASH HOLDINGS	100 %	100 %	100 %	100 %	100 %
MOMENTUM	0 %	0 %	0 %	0 %	0 %

Table 17: Distribution of statistically similar variables for losers of ICT bubble & the financial crisis

4.6 Comparing opposing market states

In this chapter, subperiods of economic expansion are compared to subperiods of economic downturn. This is done to test the hypothesis that companies in similar market states have more similarity than companies in opposing market states. The market states that are compared are the ICT bubble and the recovery period, as well as the economic boom and the financial crisis.

4.6.1 ICT bubble and recovery period

The opposing market states, economic growth and economic downturn, were compared to see if the hypothesis that periods with opposing market states have characteristically different companies under- and outperforming the market holds. The results of comparing the ICT bubble and the recovery period support this hypothesis. The mean and max results can be observed from Tables 26 and 27. The results of the Welch's t-test for winners of the ICT bubble and winners of the recovery period are shown in Table 18. The distribution of similarity among the variables of winners can be seen from Figure 10. The results of the Welch's t-test for losers of the ICT bubble and losers of the recovery period are shown in Table 19. The distribution of similarity among the variables of losers, can be seen from Figure 11:

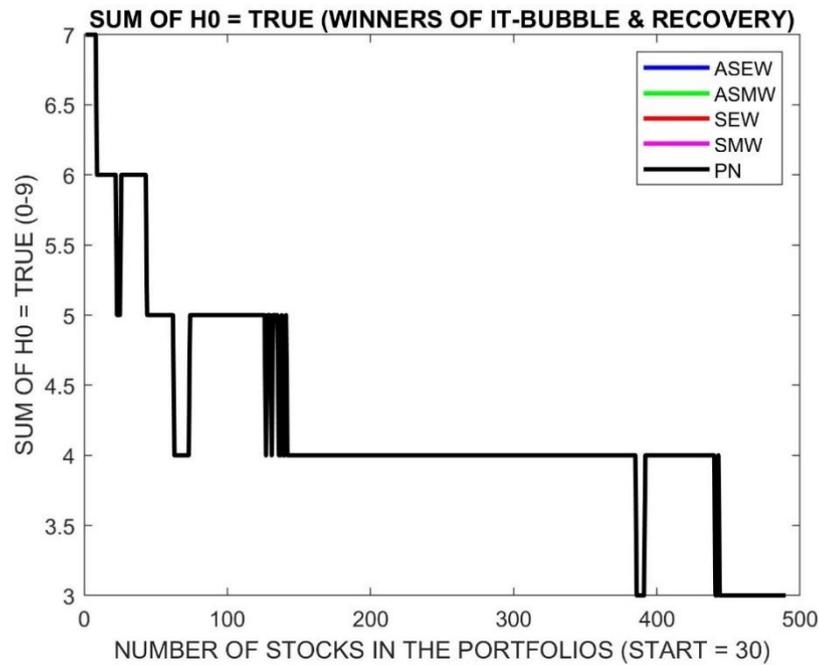


Figure 10: Amount of statistically similar variables for all portfolio sizes for winners of the ICT bubble & the recovery period

WINNERS OF ICT BUBBLE & RECOVERY					
DISTRIBUTION OF H0 = ACCEPTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	0 %	0 %	0 %	0 %	0 %
SIZE	14 %	22 %	16 %	23 %	9 %
VALUE	94 %	91 %	94 %	91 %	97 %
INVESTMENT	100 %	100 %	100 %	100 %	89 %
PROFITABILITY	100 %	100 %	100 %	100 %	100 %
OPERATING LEVERAGE	45 %	69 %	51 %	73 %	28 %
FINANCIAL LEVERAGE	96 %	94 %	96 %	94 %	98 %
CASH HOLDINGS	7 %	11 %	8 %	12 %	4 %
MOMENTUM	0 %	0 %	0 %	0 %	0 %

Table 18: Distribution of statistically similar variables for winners of the ICT bubble & the recovery period

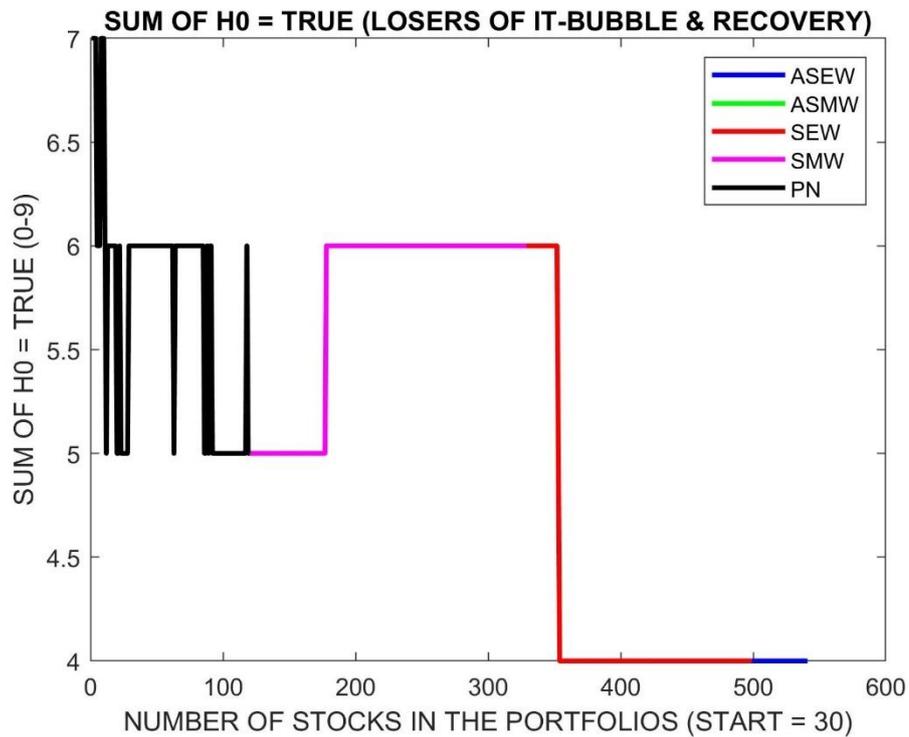


Figure 11: Amount of statistically similar variables for all portfolio sizes for losers of the ICT bubble & the recovery period

LOSERS OF ICT BUBBLE & RECOVERY					
DISTRIBUTION OF H0 = ACCEPTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	0 %	0 %	0 %	0 %	0 %
SIZE	98 %	97 %	98 %	97 %	92 %
VALUE	100 %	100 %	100 %	100 %	100 %
INVESTMENT	16 %	25 %	17 %	26 %	73 %
PROFITABILITY	100 %	100 %	100 %	100 %	100 %
OPERATING LEVERAGE	1 %	2 %	2 %	2 %	7 %
FINANCIAL LEVERAGE	100 %	100 %	100 %	100 %	100 %
CASH HOLDINGS	65 %	100 %	71 %	100 %	100 %
MOMENTUM	33 %	50 %	35 %	47 %	1 %

Table 19: Distribution of statistically similar variables for losers of the ICT bubble & the recovery period

4.6.2 The economic boom & the financial crisis

The opposing market states, economic growth and economic downturn, were compared to see whether the hypothesis that periods with opposing market states have characteristically different companies winning and losing, holds for all combinations of the subperiods. The results of comparing the financial crisis and the economic boom do not support this hypothesis. The mean and maximum results of the Welch's t-test can be observed from Tables 26 and 27. The results of the Welch's t-tests for winners of the economic boom and winners of the financial crisis are shown in Table 20. The distribution of similarity among the variables of winners can be seen from Figure 12. The results of the Welch's t-tests for losers of the economic boom and losers of the financial crisis are shown in Table 21. The distribution of similarity among the variables of losers, can be seen from Figure 13:

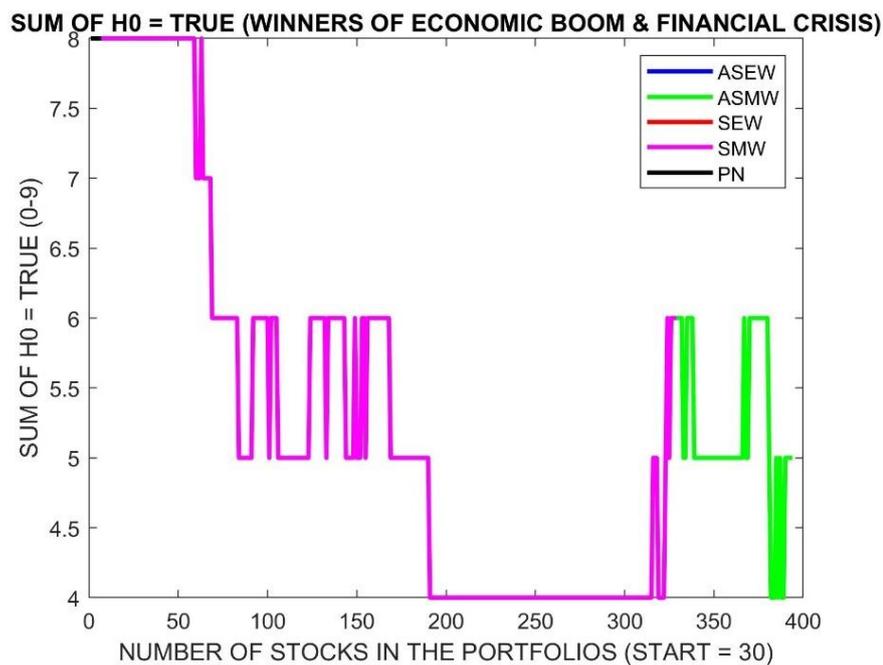


Figure 12: Amount of statistically similar variables for all portfolio sizes for winners of the economic boom & the financial crisis

WINNERS OF ECONOMIC BOOM & FINANCIAL CRISIS					
DISTRIBUTION OF H0 = ACCEPTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	0 %	0 %	0 %	0 %	0 %
SIZE	28 %	17 %	32 %	21 %	100 %
VALUE	100 %	100 %	100 %	100 %	100 %
INVESTMENT	35 %	21 %	39 %	25 %	100 %
PROFITABILITY	100 %	100 %	100 %	100 %	100 %
OPERATING LEVERAGE	54 %	42 %	61 %	42 %	100 %
FINANCIAL LEVERAGE	100 %	100 %	100 %	100 %	100 %
CASH HOLDINGS	70 %	58 %	79 %	53 %	100 %
MOMENTUM	100 %	100 %	100 %	100 %	100 %

Table 20: Distribution of statistically similar variables for winners of the economic boom & the financial crisis

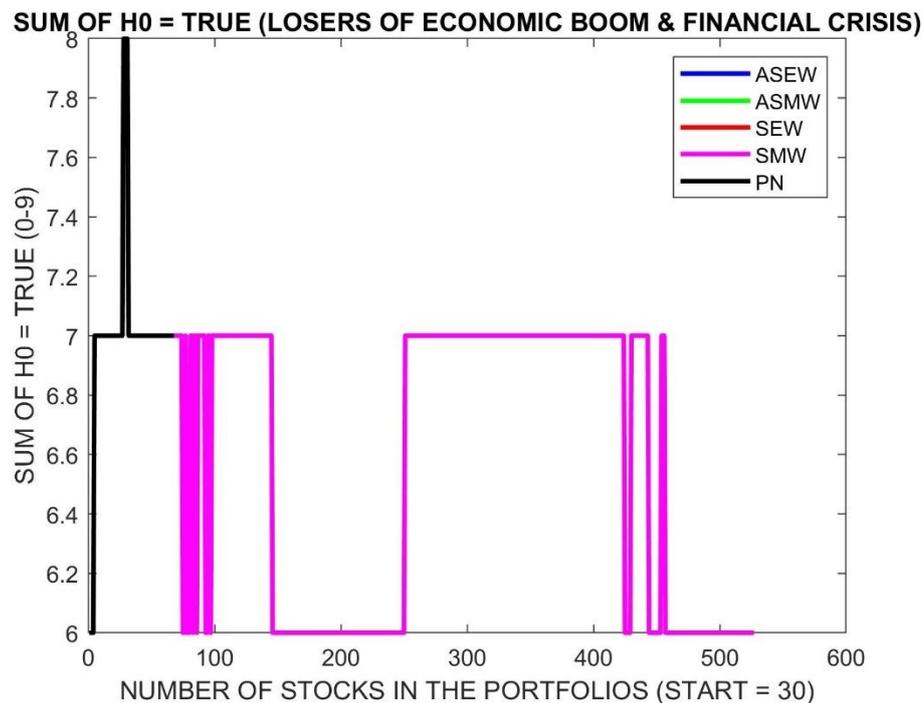


Figure 13: Amount of statistically similar variables for all portfolio sizes for losers of the economic boom & the financial crisis

LOSERS OF ECONOMIC BOOM & FINANCIAL CRISIS					
DISTRIBUTION OF H0 = ACCEPTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	0 %	0 %	0 %	0 %	0 %
SIZE	29 %	29 %	29 %	28 %	100 %
VALUE	51 %	51 %	51 %	53 %	6 %
INVESTMENT	100 %	100 %	100 %	100 %	100 %
PROFITABILITY	100 %	100 %	100 %	100 %	100 %
OPERATING LEVERAGE	87 %	87 %	88 %	83 %	100 %
FINANCIAL LEVERAGE	100 %	100 %	100 %	100 %	100 %
CASH HOLDINGS	99 %	99 %	99 %	99 %	94 %
MOMENTUM	99 %	99 %	99 %	99 %	100 %

Table 21: Distribution of statistically similar variables for losers of the economic boom & the financial crisis

4.7 Insights on Covid-19

The Covid-19 subperiod is compared to the financial crisis, as well as to the economic boom. The goal of this is to gain insight on whether the Covid-19 subperiod resembles a crisis more than a stock market boom. The Covid-19 subperiod has the highest market returns out of all the examined subperiods whereas financial crisis has the lowest market returns out of all examined subperiods.

4.7.1 Comparison with the financial crisis

The test results indicate that the winners of Covid-19 are more in common with winners in the financial crisis than with winners in the economic boom. The variables that are similar include: size, value, investment, profitability, operating leverage, financial leverage, cash holdings, and for some portfolio sizes, momentum. In line with the results of comparing the subperiods of economic expansion, this supports the hypothesis that based on characteristics of winners and losers, Covid-19 is similar to periods of economic downturn. The results of the Welch's t-tests for winners of Covid-19 and winners of the financial crisis are shown in Table 22. The distribution of similarity among the variables of winners, can be seen from Figure 14. The results of the Welch's t-tests for losers of the Covid-19 and losers of the

financial crisis are shown in Table 23. The distribution of similarity among the variables, can be seen from Figure 15:

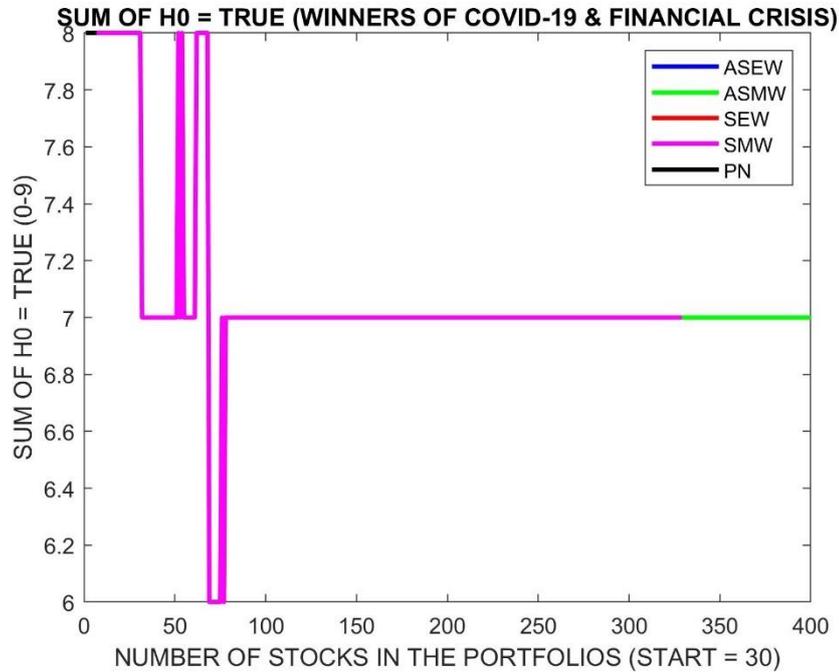


Figure 14: Amount of statistically similar variables for all portfolio sizes for winners of the Covid-19 & the financial crisis

WINNERS OF COVID-19 & FINANCIAL CRISIS					
DISTRIBUTION OF H0 = ACCEPTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	0 %	0 %	0 %	0 %	0 %
SIZE	97 %	100 %	97 %	98 %	100 %
VALUE	100 %	100 %	100 %	100 %	100 %
INVESTMENT	100 %	100 %	100 %	100 %	100 %
PROFITABILITY	100 %	100 %	100 %	100 %	100 %
OPERATING LEVERAGE	100 %	100 %	100 %	100 %	100 %
FINANCIAL LEVERAGE	100 %	100 %	100 %	100 %	100 %
CASH HOLDINGS	100 %	100 %	100 %	100 %	100 %
MOMENTUM	15 %	0 %	15 %	12 %	100 %

Table 22: Distribution of statistically similar variables for winners of the Covid-19 & the financial crisis

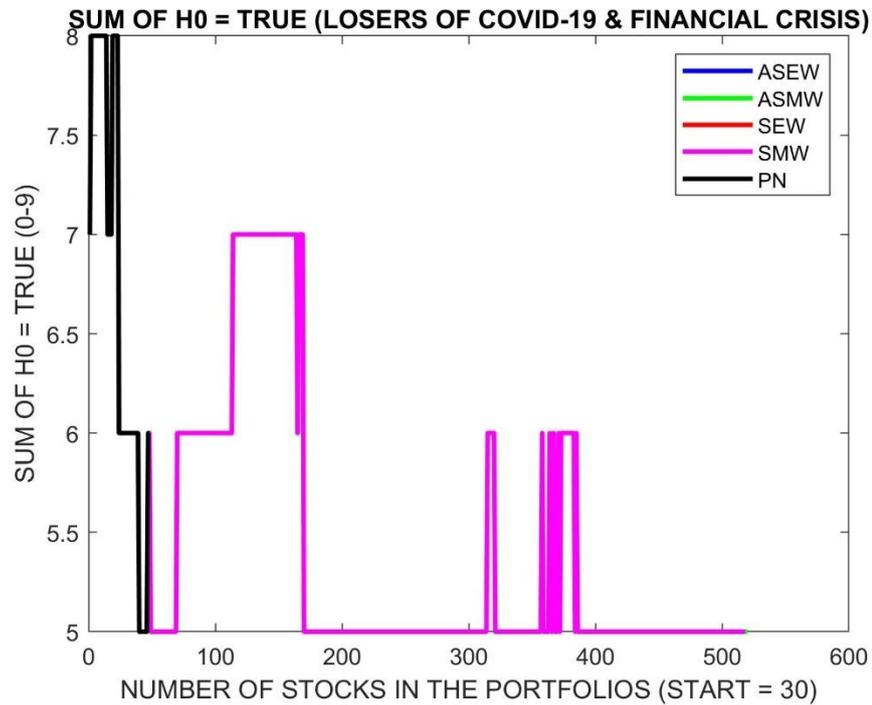


Figure 15: Amount of statistically similar variables for all portfolio sizes for losers of the Covid-19 & the financial crisis

LOSERS OF COVID-19 & FINANCIAL CRISIS					
DISTRIBUTION OF H0 = ACCEPTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	0 %	0 %	0 %	0 %	0 %
SIZE	4 %	4 %	4 %	4 %	40 %
VALUE	100 %	100 %	100 %	100 %	100 %
INVESTMENT	100 %	100 %	100 %	100 %	100 %
PROFITABILITY	100 %	100 %	100 %	100 %	100 %
OPERATING LEVERAGE	38 %	36 %	38 %	36 %	98 %
FINANCIAL LEVERAGE	94 %	95 %	94 %	95 %	85 %
CASH HOLDINGS	16 %	15 %	16 %	15 %	48 %
MOMENTUM	100 %	100 %	100 %	100 %	100 %

Table 23: Distribution of statistically similar variables for losers of the Covid-19 & the financial crisis

4.7.2 Comparison with the economic boom

The characteristics of winners and losers of Covid-19 were compared with characteristics of winners and losers in the economic boom. Based on the results of the test, the losers of Covid-19 have more in common with the losers of the economic boom than with the losers of the financial crisis. These results also support the hypothesis that Covid-19 resembles more a subperiod of economic downturn, rather than a subperiod of economic expansion, as the level of the Covid-19 periods overall similarity with the financial crisis is higher than the similarity with the economic boom. The results of the Welch's t-tests for winners of Covid-19 and winners of the economic boom are shown in Table 24. The distribution of similarity among the variables of winners, can be seen from Figure 16. The results of the Welch's t-tests for losers of the Covid-19 and losers of the economic boom are shown in Table 25. The distribution of similarity among the variables, can be seen from Figure 17:

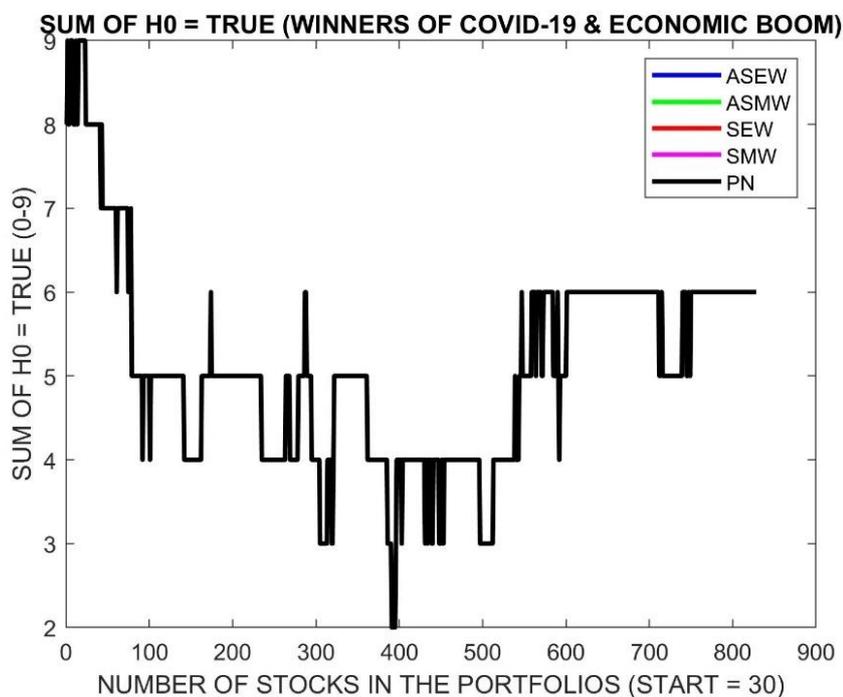


Figure 16: Amount of statistically similar variables for all portfolio sizes for winners of the Covid-19 & the economic boom

WINNERS OF COVID-19 & ECONOMIC BOOM					
DISTRIBUTION OF H0 = ACCEPTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	100 %	75 %	100 %	80 %	36 %
SIZE	98 %	77 %	100 %	83 %	37 %
VALUE	100 %	98 %	100 %	100 %	99 %
INVESTMENT	65 %	78 %	61 %	77 %	84 %
PROFITABILITY	100 %	100 %	100 %	100 %	100 %
OPERATING LEVERAGE	15 %	29 %	16 %	25 %	66 %
FINANCIAL LEVERAGE	10 %	6 %	11 %	6 %	37 %
CASH HOLDINGS	58 %	35 %	65 %	38 %	17 %
MOMENTUM	31 %	19 %	35 %	20 %	38 %

Table 24: Distribution of statistically similar variables for winners of the Covid-19 & the economic boom

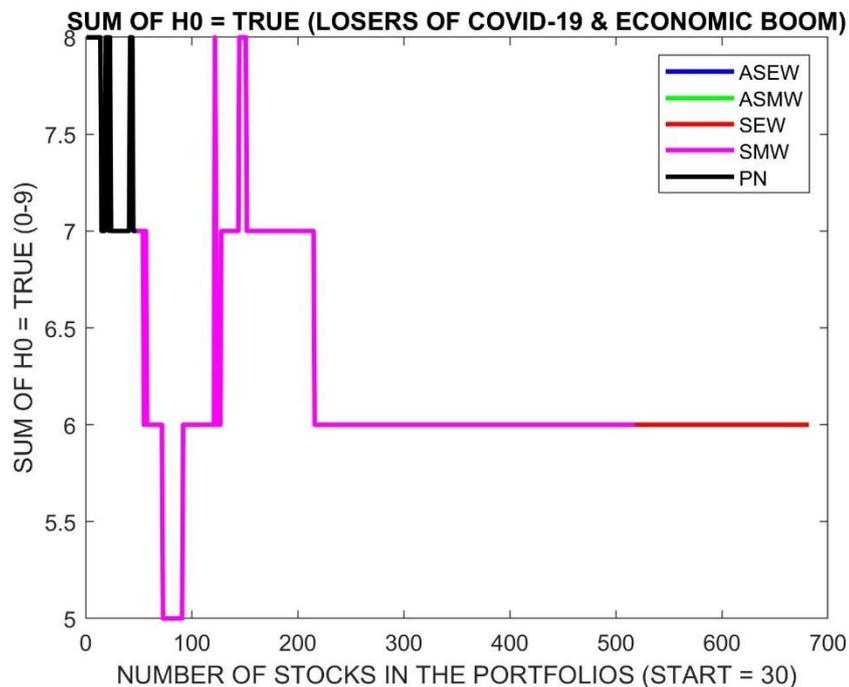


Figure 17: Amount of statistically similar variables for all portfolio sizes for losers of the Covid-19 & the economic boom

LOSERS OF COVID-19 & ECONOMIC BOOM					
DISTRIBUTION OF H0 = ACCEPTED IN VARIABLES	ASEW	ASMW	SEW	SMW	PN
TOTAL RETURNS	19 %	25 %	18 %	24 %	0 %
SIZE	12 %	15 %	11 %	15 %	41 %
VALUE	100 %	100 %	100 %	100 %	100 %
INVESTMENT	100 %	100 %	100 %	100 %	100 %
PROFITABILITY	100 %	100 %	100 %	100 %	100 %
OPERATING LEVERAGE	89 %	86 %	90 %	87 %	98 %
FINANCIAL LEVERAGE	100 %	100 %	100 %	100 %	86 %
CASH HOLDINGS	4 %	5 %	4 %	5 %	49 %
MOMENTUM	100 %	100 %	100 %	100 %	100 %

Table 25: Distribution of statistically similar variables for losers of the Covid-19 & the economic boom

4.8 Overview of comparing subperiods

The most surprising finding is that the financial crisis subperiod appears to be more similar to the economic boom than the ICT bubble, based on the characteristics of winners and losers. This can be partly explained by the findings of Campbell, Giglio & Polk (2013), where they state that the reasons for a downturn in investor sentiment in the ICT bubble and the financial crisis were very different. For the Covid-19 the results indicate that the losers of Covid-19 resemble the losers of economic boom and the winners of Covid-19 resemble the winners of the financial crisis. This supports the hypothesis that Covid-19 resembles a period of economic downturn more than a period of economic growth. After analysing the results, it is clear that the model is very sensitive to changes in the chosen portfolio size. Thus, the selection of the calculation method for market returns can have a significant effect on the results, as the calculation methods can restrict the maximum possible portfolio size. The most restrictive calculation method for the market returns is the positive-negative -split. The overview of all possible portfolio sizes gives a relatively solid understanding of the relationships of the different subperiods. Maximum and mean number of the statistically similar variables based on the Welch's t-tests for 12 combinations of winners and losers in all subperiods, with all 5 market returns, can be seen from Tables 26 and 27:

MAXIMUM NUMBER OF H0 FOR 9 VARIABLES	ASEW	ASMW	SEW	SMW	NP
WINNERS OF ECONOMIC BOOM & RECOVERY	8	8	8	8	8
LOSERS OF ECONOMIC BOOM & RECOVERY	8	8	8	8	8
WINNERS OF ICT BUBBLE & FINANCIAL CRISIS	7	7	7	7	7
LOSERS OF ICT BUBBLE & FINANCIAL CRISIS	5	5	5	5	5
WINNERS OF COVID-19 & FINANCIAL CRISIS	8	8	8	8	8
LOSERS OF COVID-19 & FINANCIAL CRISIS	8	8	8	8	8
WINNERS OF COVID-19 & ECONOMIC BOOM	9	9	9	9	9
LOSERS OF COVID-19 & ECONOMIC BOOM	8	8	8	8	8
WINNERS OF ICT BUBBLE & RECOVERY	7	7	7	7	7
LOSERS OF ICT BUBBLE & RECOVERY	7	7	7	7	7
WINNERS OF ECONOMIC BOOM & FINANCIAL CRISIS	8	8	8	8	8
LOSERS OF ECONOMIC BOOM & FINANCIAL CRISIS	8	8	8	8	8

Table 26: Maximum amount of statistically similar variables for winners vs winners & losers vs losers.

MEAN NUMBER OF H0 FOR 9 VARIABLES	ASEW	ASMW	SEW	SMW	NP
WINNERS OF ECONOMIC BOOM & RECOVERY	4,753	4,914	4,841	4,968	4,225
LOSERS OF ECONOMIC BOOM & RECOVERY	5,989	6,716	5,940	6,758	7,603
WINNERS OF ICT BUBBLE & FINANCIAL CRISIS	4,994	4,978	4,978	5	6,429
LOSERS OF ICT BUBBLE & FINANCIAL CRISIS	3,643	3,715	3,642	3,763	3,609
WINNERS OF COVID-19 & FINANCIAL CRISIS	7,120	7,080	7,117	7,097	8
LOSERS OF COVID-19 & FINANCIAL CRISIS	5,519	5,498	5,521	5,500	6,708
WINNERS OF COVID-19 & ECONOMIC BOOM	5,762	5,168	5,874	5,282	5,135
LOSERS OF COVID-19 & ECONOMIC BOOM	6,237	6,311	6,229	6,301	7,438
WINNERS OF ICT BUBBLE & RECOVERY	4,577	4,873	4,647	4,925	4,239
LOSERS OF ICT BUBBLE & RECOVERY	5,135	5,741	5,230	5,723	5,717
WINNERS OF ECONOMIC BOOM & FINANCIAL CRISIS	5,879	5,376	6,098	5,410	8
LOSERS OF ECONOMIC BOOM & FINANCIAL CRISIS	6,653	6,649	6,656	6,619	7

Table 27: Mean amount of statistically similar variables for winners vs winners & losers vs losers.

4.9 Welch's t-test results for the chosen portfolio sizes

The chosen portfolio sizes for further analysis are 50%, 30% and 10%. The portfolios are formed from the data that is split to winners and losers based on market returns. After the split, the number of stocks in the portfolio with fewer stocks represents the upper bound for the fractile size. The 50% portfolio size means that the maximum portfolio size after the split

is used. The analysis is conducted for winners against losers, winners against winners and losers against losers in all individual subperiods and by comparing subperiods.

4.9.1 Comparing winners and losers in the same subperiod

For the examined portfolio sizes of 50%, 30% and 10%, the results of the ICT bubble show the least similarity when comparing winners and losers. This can be partly due to the fact that changing the fractile size can have a significant effect on the results as can be seen from the earlier figures, but the results are in line with the earlier tests. The results of Welch's t-tests for winners and losers in the same subperiods with 50%, 30% and 10% portfolio-sizes are presented in Tables 28-30:

50% FRACTILES (WINNERS VS LOSERS)											
IT-BUBBLE	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	SUM H1 = ACCEPTED	
ASEW (391 stocks per portfolio)	1	1	1	0	1	1	0	1	1	1	7
ASMW (380 stocks per portfolio)	1	1	1	0	1	1	0	1	1	1	7
SEW (433 stocks per portfolio)	1	1	0	0	1	1	0	1	1	1	6
SMW (358 stocks per portfolio)	1	1	1	1	1	1	0	1	1	1	8
PN (441 stocks per portfolio)	1	1	1	0	1	1	1	1	1	1	8
ECONOMIC BOOM	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM		
ASEW (268 stocks per portfolio)	1	1	0	1	1	1	0	0	0	0	5
ASMW (423 stocks per portfolio)	1	1	0	1	1	1	0	0	0	0	5
SEW (243 stocks per portfolio)	1	1	0	1	1	1	0	0	0	0	5
SMW (398 stocks per portfolio)	1	0	0	1	1	1	0	0	0	0	4
PN (97 stocks per portfolio)	1	0	0	1	1	0	0	0	0	0	3
FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM		
ASEW (480 stocks per portfolio)	1	1	0	0	1	0	0	0	0	0	3
ASMW (429 stocks per portfolio)	1	1	1	0	1	0	0	0	0	0	4
SEW (243 stocks per portfolio)	1	1	1	0	1	0	0	0	0	0	4
SMW (358 stocks per portfolio)	1	1	1	0	1	0	0	0	0	0	4
PN (36 stocks per portfolio)	1	0	0	1	0	0	0	0	0	0	2
RECOVERY	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM		
ASEW (327 stocks per portfolio)	1	1	0	1	0	1	0	0	0	0	4
ASMW (226 stocks per portfolio)	1	1	0	1	0	1	0	0	0	1	5
SEW (295 stocks per portfolio)	1	1	0	1	0	1	0	0	0	0	4
SMW (215 stocks per portfolio)	1	1	0	1	0	1	0	0	0	1	5
PN (149 stocks per portfolio)	1	1	0	1	0	1	0	0	0	0	4
COVID-19	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM		
ASEW (301 stocks per portfolio)	1	0	0	0	0	0	1	0	1	1	3
ASMW (467 stocks per portfolio)	1	0	0	0	0	0	0	0	1	1	2
SEW (302 stocks per portfolio)	1	0	0	0	0	0	1	0	1	1	3
SMW (469 stocks per portfolio)	1	0	0	0	0	0	0	0	1	1	2
PN (77 stocks per portfolio)	1	1	0	0	0	0	0	1	0	1	3

Table 28: The results of Welch's t-tests for winners vs losers in all subperiods with 50% fractiles

30% FRACTILES (WINNERS VS LOSERS)										
IT-BUBBLE	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	SUM H1 = ACCEPTED
ASEW (235 stocks per portfolio)	1	1	0	0	0	1	1	1	1	6
ASMW (228 stocks per portfolio)	1	0	1	1	1	1	1	0	1	7
SEW (260 stocks per portfolio)	1	1	1	0	1	1	0	1	1	7
SMW (215 stocks per portfolio)	1	0	1	1	1	1	0	1	1	7
PN (265 stocks per portfolio)	1	1	1	0	1	1	1	0	1	7
ECONOMIC BOOM	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (161 stocks per portfolio)	1	0	0	1	1	1	0	0	0	4
ASMW (254 stocks per portfolio)	1	1	0	1	1	1	0	0	0	5
SEW (146 stocks per portfolio)	1	0	0	1	1	0	0	0	0	3
SMW (239 stocks per portfolio)	1	1	0	1	1	1	0	0	0	5
PN (58 stocks per portfolio)	1	0	0	1	1	0	0	0	0	3
FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (288 stocks per portfolio)	1	1	1	0	1	0	0	0	0	4
ASMW (257 stocks per portfolio)	1	1	1	0	1	0	0	0	0	4
SEW (146 stocks per portfolio)	1	0	0	0	1	0	0	0	0	2
SMW (215 stocks per portfolio)	1	1	1	0	1	0	0	0	0	4
PN (Not significant)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
RECOVERY	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (196 stocks per portfolio)	1	1	0	1	0	1	0	0	1	5
ASMW (136 stocks per portfolio)	1	0	0	1	0	1	0	0	0	3
SEW (177 stocks per portfolio)	1	1	0	1	0	1	0	0	0	4
SMW (129 stocks per portfolio)	1	0	0	1	0	1	0	0	1	4
PN (90 stocks per portfolio)	1	1	0	1	0	1	0	0	0	4
COVID-19	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (181 stocks per portfolio)	1	0	0	0	0	0	0	1	1	3
ASMW (280 stocks per portfolio)	1	1	0	0	0	1	1	1	1	6
SEW (181 stocks per portfolio)	1	0	0	0	0	0	0	1	1	3
SMW (281 stocks per portfolio)	1	1	0	0	0	1	1	1	1	6
PN (46 stocks per portfolio)	1	0	0	0	0	0	0	0	0	1

Table 29: The results of Welch's t-tests for winners vs losers in all subperiods with 30% fractiles

10% FRACTILES (WINNERS VS LOSERS)										
IT-BUBBLE	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	SUM H1 = ACCEPTED
ASEW (78 stocks per portfolio)	1	0	1	0	1	0	1	0	1	5
ASMW (76 stocks per portfolio)	1	0	1	0	1	0	1	0	1	5
SEW (87 stocks per portfolio)	1	0	1	0	1	0	1	0	1	5
SMW (72 stocks per portfolio)	1	0	1	0	1	0	1	0	1	5
PN (88 stocks per portfolio)	1	0	1	0	1	0	1	0	1	5
ECONOMIC BOOM	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (54 stocks per portfolio)	1	0	0	1	0	0	0	0	0	2
ASMW (85 stocks per portfolio)	1	0	0	1	1	0	0	0	0	3
SEW (49 stocks per portfolio)	1	0	0	1	0	0	0	0	0	2
SMW (80 stocks per portfolio)	1	0	0	1	1	0	0	0	0	3
PN (Not significant)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (96 stocks per portfolio)	1	1	1	1	0	0	0	0	0	4
ASMW (86 stocks per portfolio)	1	1	1	1	0	0	0	0	0	4
SEW (49 stocks per portfolio)	1	0	1	1	0	0	0	0	0	3
SMW (72 stocks per portfolio)	1	1	1	1	0	0	0	0	0	4
PN (Not significant)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
RECOVERY	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (65 stocks per portfolio)	1	0	0	1	0	1	0	0	1	4
ASMW (45 stocks per portfolio)	1	0	0	1	0	0	0	0	0	2
SEW (59 stocks per portfolio)	1	0	0	1	0	0	0	0	0	2
SMW (43 stocks per portfolio)	1	0	0	1	0	0	0	0	1	3
PN (30 stocks per portfolio)	1	0	0	1	0	0	0	0	0	2
COVID-19	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (60 stocks per portfolio)	1	0	0	0	0	0	0	0	0	1
ASMW (93 stocks per portfolio)	1	1	0	0	0	0	1	1	0	4
SEW (60 stocks per portfolio)	1	0	0	0	0	0	0	0	0	1
SMW (94 stocks per portfolio)	1	1	0	0	0	0	1	1	0	4
PN (Not significant)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0

Table 30: The results of Welch's t-tests for winners vs losers in all subperiods with 10% fractiles

4.9.2 Comparing winners and losers in different subperiods

For the chosen portfolio sizes of 50%, 30% and 10%, the results of comparing different subperiods show that decreasing the fractile size increases similarity in similar market states. The most drastic change in similarity is seen when comparing the 30% fractile results to the 10% fractile results for Covid-19 against the economic boom and the economic boom against the financial crisis. The results of Welch's t-tests for comparing winners to winners and losers to losers in all subperiods with 50%, 30% and 10% portfolio sizes are presented in Tables 31-36:

50% FRACTILES (WINNERS VS WINNERS)											
	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	SUM H1 = ACCEPTED	
ECONOMIC BOOM / RECOVERY											
ASEW (268 stocks per portfolio)	1	1	0	1	0	0	0	1	1	1	5
ASMW (226 stocks per portfolio)	1	1	0	1	0	0	0	1	1	1	5
SEW (243 stocks per portfolio)	1	1	0	1	0	0	0	1	1	1	5
SMW (215 stocks per portfolio)	1	1	0	1	0	0	0	1	1	1	5
PN (829 stocks per portfolio)	1	1	0	1	0	0	0	1	1	1	5
IT-BUBBLE / FINANCIAL CRISIS											
ASEW (391 stocks per portfolio)	1	1	0	0	0	1	0	1	1	1	5
ASMW (429 stocks per portfolio)	1	1	0	0	0	1	0	1	0	1	4
SEW (433 stocks per portfolio)	1	1	0	0	0	1	0	1	0	1	4
SMW (358 stocks per portfolio)	1	1	0	0	0	0	0	1	1	1	4
PN (36 stocks per portfolio)	1	0	0	0	0	1	0	0	1	1	3
COVID-19 / FINANCIAL CRISIS											
ASEW (301 stocks per portfolio)	1	0	0	0	0	0	0	0	1	1	2
ASMW (429 stocks per portfolio)	1	0	0	0	0	0	0	0	1	1	2
SEW (302 stocks per portfolio)	1	0	0	0	0	0	0	0	1	1	2
SMW (358 stocks per portfolio)	1	0	0	0	0	0	0	0	1	1	2
PN (36 stocks per portfolio)	1	0	0	0	0	0	0	0	1	1	1
COVID-19 / ECONOMIC BOOM											
ASEW (268 stocks per portfolio)	0	1	0	0	0	1	1	1	1	1	5
ASMW (423 stocks per portfolio)	1	1	1	1	0	0	1	1	1	1	7
SEW (243 stocks per portfolio)	0	0	0	0	0	1	1	1	1	1	4
SMW (398 stocks per portfolio)	1	1	0	0	0	0	1	1	1	1	5
PN (857 stocks per portfolio)	1	1	0	0	0	0	0	1	0	1	3
IT-BUBBLE / RECOVERY											
ASEW (327 stocks per portfolio)	1	1	0	0	0	1	0	1	1	1	5
ASMW (226 stocks per portfolio)	1	1	0	0	0	1	0	1	1	1	5
SEW (295 stocks per portfolio)	1	1	0	0	0	1	0	1	1	1	5
SMW (215 stocks per portfolio)	1	1	0	0	0	1	0	1	1	1	5
PN (519 stocks per portfolio)	1	1	0	1	0	1	0	1	1	1	6
ECONOMIC BOOM / FINANCIAL CRISIS											
ASEW (268 stocks per portfolio)	1	1	0	1	0	1	0	1	0	1	5
ASMW (423 stocks per portfolio)	1	1	0	1	0	0	0	1	0	1	4
SEW (243 stocks per portfolio)	1	1	0	1	0	1	0	1	0	1	5
SMW (358 stocks per portfolio)	1	1	0	1	0	0	0	0	0	1	3
PN (36 stocks per portfolio)	1	0	0	0	0	0	0	0	0	1	1

Table 31: Welch's T-test results for 50% fractiles winners against winners

50% FRACTILES (LOSERS VS LOSERS)										
ECONOMIC BOOM / RECOVERY	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	SUM H1 = ACCEPTED
ASEW (651 stocks per portfolio)	1	0	0	1	0	0	0	1	1	4
ASMW (226 stocks per portfolio)	1	0	0	1	0	0	0	0	1	3
SEW (683 stocks per portfolio)	1	0	0	1	0	0	0	1	1	4
SMW (215 stocks per portfolio)	1	0	0	1	0	0	0	0	1	3
PN (97 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
IT-BUBBLE / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (528 stocks per portfolio)	1	1	1	1	0	0	0	0	1	5
ASMW (380 stocks per portfolio)	1	1	1	1	0	1	0	0	1	6
SEW (526 stocks per portfolio)	1	1	1	1	0	0	0	0	1	5
SMW (358 stocks per portfolio)	1	1	1	1	0	1	0	0	1	6
PN (441 stocks per portfolio)	1	1	1	1	0	1	0	0	1	6
COVID-19 / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (528 stocks per portfolio)	1	1	0	0	0	1	0	1	0	4
ASMW (549 stocks per portfolio)	1	1	0	0	0	1	0	1	0	4
SEW (526 stocks per portfolio)	1	1	0	0	0	1	0	1	0	4
SMW (547 stocks per portfolio)	1	1	0	0	0	1	0	1	0	4
PN (77 stocks per portfolio)	1	1	0	0	0	0	0	1	0	3
COVID-19 / ECONOMIC BOOM	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (686 stocks per portfolio)	1	1	0	0	0	0	0	1	0	3
ASMW (531 stocks per portfolio)	1	1	0	0	0	0	0	1	0	3
SEW (711 stocks per portfolio)	1	1	0	0	0	0	0	1	0	3
SMW (547 stocks per portfolio)	1	1	0	0	0	0	0	1	0	3
PN (77 stocks per portfolio)	1	0	0	0	0	0	0	1	0	2
IT-BUBBLE / RECOVERY	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (570 stocks per portfolio)	1	0	0	1	0	1	0	1	1	5
ASMW (380 stocks per portfolio)	1	0	0	1	0	1	0	0	0	3
SEW (528 stocks per portfolio)	1	0	0	1	0	1	0	1	1	5
SMW (358 stocks per portfolio)	1	0	0	1	0	1	0	0	0	3
PN (149 stocks per portfolio)	1	0	0	1	0	1	0	0	1	4
ECONOMIC BOOM / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (528 stocks per portfolio)	1	1	0	0	0	1	0	0	0	3
ASMW (531 stocks per portfolio)	1	1	0	0	0	1	0	0	0	3
SEW (526 stocks per portfolio)	1	1	0	0	0	1	0	0	0	3
SMW (556 stocks per portfolio)	1	1	0	0	0	1	0	0	0	3
PN (97 stocks per portfolio)	1	0	1	0	0	0	0	0	0	2

Table 32: Welch’s T-test results for 50% fractiles losers against losers

30% FRACTILES (WINNERS VS WINNERS)										
ECONOMIC BOOM / RECOVERY	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	SUM H1 = ACCEPTED
ASEW (161 stocks per portfolio)	1	1	0	1	0	0	0	1	1	5
ASMW (136 stocks per portfolio)	1	1	0	1	0	0	0	1	1	5
SEW (146 stocks per portfolio)	1	1	0	1	0	0	0	1	1	5
SMW (129 stocks per portfolio)	1	1	0	1	0	0	0	1	1	5
PN (497 stocks per portfolio)	1	1	0	1	0	0	0	1	1	5
IT-BUBBLE / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (234 stocks per portfolio)	1	1	0	0	0	0	0	1	1	4
ASMW (257 stocks per portfolio)	1	1	0	0	0	0	0	1	1	4
SEW (260 stocks per portfolio)	1	1	0	0	0	0	0	1	1	4
SMW (215 stocks per portfolio)	1	1	0	0	0	0	0	1	1	4
PN (Not significant)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
COVID-19 / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (181 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
ASMW (257 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
SEW (181 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
SMW (215 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
PN (Not significant)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
COVID-19 / ECONOMIC BOOM	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (161 stocks per portfolio)	0	0	0	1	0	1	1	0	1	4
ASMW (254 stocks per portfolio)	0	0	0	0	0	1	1	1	1	4
SEW (146 stocks per portfolio)	0	0	0	1	0	1	1	0	1	4
SMW (239 stocks per portfolio)	0	0	0	0	0	1	1	1	1	4
PN (514 stocks per portfolio)	1	1	0	0	0	0	1	1	1	5
IT-BUBBLE / RECOVERY	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (196 stocks per portfolio)	1	1	0	0	0	1	0	1	1	5
ASMW (136 stocks per portfolio)	1	1	0	0	0	0	0	1	1	4
SEW (177 stocks per portfolio)	1	1	0	0	0	1	0	1	1	5
SMW (129 stocks per portfolio)	1	1	0	0	0	0	0	1	1	4
PN (311 stocks per portfolio)	1	1	0	0	0	1	0	1	1	5
ECONOMIC BOOM / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (161 stocks per portfolio)	1	1	0	1	0	0	0	0	0	3
ASMW (254 stocks per portfolio)	1	1	0	1	0	1	0	1	0	5
SEW (146 stocks per portfolio)	1	1	0	1	0	1	0	0	0	4
SMW (215 stocks per portfolio)	1	1	0	1	0	0	0	1	0	4
PN (Not significant)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0

Table 33: Welch’s T-test results for 30% fractiles winners against winners

30% FRACTILES (LOSERS VS LOSERS)										
ECONOMIC BOOM / RECOVERY	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	SUM H1 = ACCEPTED
ASEW (391 stocks per portfolio)	1	0	0	1	0	0	0	0	1	3
ASMW (136 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
SEW (410 stocks per portfolio)	1	0	0	1	0	0	0	0	1	3
SMW (129 stocks per portfolio)	1	0	0	1	0	0	0	0	1	3
PN (58 stocks per portfolio)	0	0	0	0	0	0	0	0	1	1
IT-BUBBLE / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (317 stocks per portfolio)	1	1	1	1	0	1	0	0	1	6
ASMW (228 stocks per portfolio)	1	0	1	1	0	1	0	0	1	5
SEW (316 stocks per portfolio)	1	1	1	1	0	1	0	0	1	6
SMW (215 stocks per portfolio)	1	0	1	1	0	1	0	0	1	5
PN (265 stocks per portfolio)	1	1	1	1	0	1	0	0	1	6
COVID-19 / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (317 stocks per portfolio)	1	1	0	0	0	1	0	1	0	4
ASMW (329 stocks per portfolio)	1	1	0	0	0	1	0	1	0	4
SEW (316 stocks per portfolio)	1	1	0	0	0	1	0	1	0	4
SMW (328 stocks per portfolio)	1	1	0	0	0	1	0	1	0	4
PN (46 stocks per portfolio)	1	1	0	0	0	0	0	0	0	2
COVID-19 / ECONOMIC BOOM	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (412 stocks per portfolio)	1	1	0	0	0	0	0	1	0	3
ASMW (319 stocks per portfolio)	1	1	0	0	0	0	0	1	0	3
SEW (427 stocks per portfolio)	1	1	0	0	0	0	0	1	0	3
SMW (328 stocks per portfolio)	1	1	0	0	0	0	0	1	0	3
PN (46 stocks per portfolio)	1	1	0	0	0	0	0	0	0	2
IT-BUBBLE / RECOVERY	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (342 stocks per portfolio)	1	0	0	1	0	1	0	0	0	3
ASMW (228 stocks per portfolio)	1	0	0	1	0	1	0	0	0	3
SEW (317 stocks per portfolio)	1	0	0	1	0	1	0	0	0	3
SMW (215 stocks per portfolio)	1	0	0	1	0	1	0	0	0	3
PN (90 stocks per portfolio)	1	0	0	0	0	1	0	0	1	3
ECONOMIC BOOM / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (317 stocks per portfolio)	1	1	0	0	0	0	0	0	0	2
ASMW (319 stocks per portfolio)	1	1	0	0	0	0	0	0	0	2
SEW (316 stocks per portfolio)	1	1	0	0	0	0	0	0	0	2
SMW (334 stocks per portfolio)	1	1	0	0	0	0	0	0	0	2
PN (58 stocks per portfolio)	1	0	0	0	0	0	0	0	0	1

Table 34: Welch’s T-test results for 30% fractiles losers against losers

10% FRACTILES (WINNERS VS WINNERS)										
ECONOMIC BOOM / RECOVERY	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	SUM H1 = ACCEPTED
ASEW (54 stocks per portfolio)	1	0	1	0	0	0	0	0	1	3
ASMW (45 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
SEW (49 stocks per portfolio)	1	0	1	0	0	0	0	0	1	3
SMW (43 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
PN (166 stocks per portfolio)	1	1	0	1	0	0	0	1	1	5
IT-BUBBLE / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (106 stocks per portfolio)	1	1	0	0	0	1	0	0	1	4
ASMW (76 stocks per portfolio)	1	1	0	0	0	1	0	0	1	4
SEW (105 stocks per portfolio)	1	1	0	0	0	1	0	0	1	4
SMW (72 stocks per portfolio)	1	0	0	0	0	1	0	0	1	3
PN (Not significant)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
COVID-19 / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (60 stocks per portfolio)	1	0	0	0	0	0	0	0	0	1
ASMW (86 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
SEW (60 stocks per portfolio)	1	0	0	0	0	0	0	0	0	1
SMW (72 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
PN (Not significant)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
COVID-19 / ECONOMIC BOOM	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (54 stocks per portfolio)	0	0	0	0	0	0	1	0	0	1
ASMW (85 stocks per portfolio)	0	0	0	0	0	1	1	0	0	2
SEW (49 stocks per portfolio)	0	0	0	0	0	0	0	0	0	0
SMW (80 stocks per portfolio)	0	0	0	0	0	1	1	0	0	2
PN (171 stocks per portfolio)	0	0	0	1	0	1	1	1	1	5
IT-BUBBLE / RECOVERY	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (65 stocks per portfolio)	1	0	0	0	0	0	0	1	1	3
ASMW (45 stocks per portfolio)	1	0	1	0	0	0	0	0	1	3
SEW (59 stocks per portfolio)	1	0	0	0	0	0	0	1	1	3
SMW (43 stocks per portfolio)	1	0	1	0	0	0	0	0	1	3
PN (104 stocks per portfolio)	1	1	0	0	0	0	0	1	1	4
ECONOMIC BOOM / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (54 stocks per portfolio)	1	0	0	0	0	0	0	0	0	1
ASMW (85 stocks per portfolio)	1	0	0	0	0	0	0	0	0	1
SEW (49 stocks per portfolio)	1	0	0	0	0	0	0	0	0	1
SMW (72 stocks per portfolio)	1	0	0	0	0	0	0	0	0	1
PN (Not significant)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0

Table 35: Welch’s T-test results for 10% fractiles winners against winners

10% FRACTILES (LOSERS VS LOSERS)										
ECONOMIC BOOM / RECOVERY	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	SUM H1 = ACCEPTED
ASEW (130 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
ASMW (45 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
SEW (137 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
SMW (43 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
PN (Not significant)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
IT-BUBBLE / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (106 stocks per portfolio)	1	0	1	0	0	1	0	0	1	4
ASMW (76 stocks per portfolio)	1	0	1	0	0	1	0	0	1	4
SEW (105 stocks per portfolio)	1	0	1	0	0	1	0	0	1	4
SMW (72 stocks per portfolio)	1	1	1	0	0	1	0	0	1	5
PN (88 stocks per portfolio)	1	0	1	0	0	1	0	0	1	4
COVID-19 / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (106 stocks per portfolio)	1	1	0	0	0	0	0	1	0	3
ASMW (110 stocks per portfolio)	1	1	0	0	0	0	0	1	0	3
SEW (106 stocks per portfolio)	1	1	0	0	0	0	0	1	0	3
SMW (109 stocks per portfolio)	1	1	0	0	0	0	0	1	0	3
PN (Not significant)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
COVID-19 / ECONOMIC BOOM	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (137 stocks per portfolio)	0	1	0	0	0	1	0	1	0	3
ASMW (106 stocks per portfolio)	1	1	0	0	0	1	0	1	0	4
SEW (142 stocks per portfolio)	0	1	0	0	0	1	0	1	0	3
SMW (109 stocks per portfolio)	1	1	0	0	0	1	0	1	0	4
PN (Not significant)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
IT-BUBBLE / RECOVERY	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (114 stocks per portfolio)	1	0	0	0	0	1	0	0	1	3
ASMW (76 stocks per portfolio)	1	0	0	0	0	1	0	0	1	3
SEW (106 stocks per portfolio)	1	0	0	0	0	1	0	0	1	3
SMW (72 stocks per portfolio)	1	0	0	0	0	1	0	0	1	3
PN (30 stocks per portfolio)	1	0	0	0	0	0	0	0	1	2
ECONOMIC BOOM / FINANCIAL CRISIS	TOTAL RETURNS	SIZE	VALUE	INVESTMENT	PROFITABILITY	OPER. LEV.	FIN. LEV.	CASH HOLDINGS	MOMENTUM	
ASEW (106 stocks per portfolio)	1	0	1	0	0	0	0	0	0	2
ASMW (106 stocks per portfolio)	1	0	1	0	0	0	0	0	0	2
SEW (105 stocks per portfolio)	1	0	1	0	0	0	0	0	1	3
SMW (111 stocks per portfolio)	1	0	1	0	0	0	0	0	0	2
PN (Not significant)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0

Table 36: Welch's T-test results for 10% fractiles losers against losers

4.10 Cross-sectional regressions

The cross-sectional regression analysis is conducted for all subperiods separately. All available data is included in the analysis. The response variable is total returns and the explanatory variables in the model are size, value, investment, profitability, operating leverage, financial leverage, cash holdings and momentum. The variables were normalized by using Z-score normalization. The initial cross-sectional regressions are multiple linear regressions conducted with the Ordinary Least Squares -method. The OLS regressions are conducted in order to get inputs for the White test.

4.11 The White test

The White test is conducted to check for heteroscedasticity in the residuals of the OLS multiple linear regression model. While the ordinary least squares estimator is still unbiased

in the presence of heteroscedasticity, it is inefficient and robust standard errors should be used instead. The results of the White test are presented in table 37:

Subperiod	p-value
ICT bubble	0
Economic boom	0.002
Financial crisis	0.938
Recovery period	0.019
Covid-19 period	0

Table 37: The p-values of the White test for all subperiods

The results of the White test indicate that the OLS regression models' residuals have heteroscedasticity only in the financial crisis -subperiod. According to the Gauss-Markov theorem, for the subperiods that have heteroscedasticity in the residuals, the OLS regression is not the Best Linear Unbiased Estimator (BLUE). (Theil 1971) The issue is fixed by using heteroscedasticity-robust standard errors in the OLS regression. (Huber 1967)

4.12 OLS results with Huber-White robust standard errors

The regression statistics are based on the heteroscedasticity-corrected standard errors, following the Huber-White adjustment procedure. In the ICT bubble the statistically significant explanatory variables are value, investment, financial leverage, cash holdings and momentum. Based on the regression coefficients, the linear relationship with total returns is significantly positive for momentum while being negative for value, investment, financial leverage, and cash holdings. The adjusted R-squared statistic of 0.289 is notably high for a cross-sectional regression model. Based on the F-statistic the model is statistically significant with even at the 1% risk level. The regression results for the ICT bubble are presented in Table 38:

Number of obs	=	961
F(8, 952)	=	28.43
Prob > F	=	0.0000
R-squared	=	0.2948
Root MSE	=	.84329
Adjusted R ²	=	0.289

TOTAL RETURNS	Coefficient	Robust std. err.	t	P> t	[95% conf. interval]	
SIZE	.009	.026	0.33	0.743	-.043	.060
VALUE	-.090	.030	-3.03	0.003	-.148	-.032
INVESTMENT	-.041	.021	-1.97	0.049	-.083	-.000
PROFITABILITY	.015	.044	0.35	0.728	-.071	.102
OPERATING LEVERAGE	-.004	.028	-0.16	0.874	-.059	.050
FINANCIAL LEVERAGE	-.067	.021	-3.21	0.001	-.107	-.026
CASH HOLDINGS	-.115	.028	-4.16	0.000	-.169	-.061
MOMENTUM	.518	.042	12.25	0.000	.435	.601
_cons	-1.10e-16	.027	-0.00	1.000	-.053	.053

Table 38: OLS regression results for the ICT bubble with robust standard errors.

During the economic boom, the statistically significant explanatory variables are size, investment, operating leverage, and financial leverage. Based on the regression coefficients the linear relationship with total returns is positive for investment and negative for size, operating leverage and financial leverage. The adjusted R-squared statistic of 0.0423 is relatively low, but scores below 0.10 are very common in cross-sectional regressions. Based on the F-statistic the model is statistically significant with even at the 1% risk level. The regression results for the economic boom are presented in Table 39:

Number of obs	=	954
F(8, 945)	=	3.72
Prob > F	=	0.0003
R-squared	=	0.0423
Root MSE	=	.98278
Adjusted R ²	=	0.0342

TOTAL RETURNS	Coefficient	Robust std. err.	t	P> t	[95% conf. interval]	
SIZE	-.057	.017	-3.41	0.001	-.090	-.024
VALUE	-.000	.009	-0.04	0.964	-.018	.017
INVESTMENT	.187	.073	2.57	0.010	.044	.330
PROFITABILITY	.015	.011	1.35	0.178	-.007	.036
OPERATING LEVERAGE	-.059	.024	-2.47	0.014	-.106	-.012
FINANCIAL LEVERAGE	-.025	.009	-2.88	0.004	-.043	-.008
CASH HOLDINGS	.011	.015	0.72	0.473	-.019	.042
MOMENTUM	-.076	.039	-1.93	0.054	-.153	.001
_cons	-1.08e-17	.032	-0.00	1.000	-.062	.062

Table 39: OLS regression results for the economic boom with robust standard errors.

In the financial crisis the statistically significant explanatory variables are size, investment, profitability and cash holdings. Based on the regression coefficients the linear relationship with total returns is positive for size, investment, and profitability and negative for cash holdings. The adjusted R-squared statistic of 0.0216 is relatively low. Based on the F-statistic, the model is statistically significant with even at the 1% risk level. The regression results for the financial crisis are presented in Table 40:

Number of obs	=	1,008
F(8, 999)	=	4.17
Prob > F	=	0.0001
R-squared	=	0.0216
Root MSE	=	.9931
Adjusted R ²	=	0.0138

TOTAL RETURNS	Coefficient	Robust				[95% conf. interval]	
		std. err.	t	P> t			
SIZE	.170	.046	3.67	0.000	.079	.260	
VALUE	.015	.029	0.52	0.600	-.042	.073	
INVESTMENT	.079	.045	1.75	0.080	-.009	.167	
PROFITABILITY	.054	.022	2.41	0.016	.010	.097	
OPERATING LEVERAGE	.002	.031	0.07	0.946	-.058	.062	
FINANCIAL LEVERAGE	-.008	.046	-0.17	0.867	-.099	.083	
CASH HOLDINGS	-.111	.054	-2.06	0.039	-.216	-.005	
MOMENTUM	-.006	.030	-0.20	0.842	-.065	.053	
_cons	6.85e-16	.031	0.00	1.000	-.061	.061	

Table 40: OLS regression results for the financial crisis with robust standard errors.

In the recovery period the statistically significant explanatory variables are size, investment, profitability, cash holdings and momentum. Based on the regression coefficients the linear relationship with total returns is positive for size and investment and negative for profitability, cash holdings and momentum. The adjusted R-squared statistic of 0.0614 is relatively low. Based on the F-statistic the model is statistically significant with even at the 1% risk level. The regression results for the recovery period are presented in Table 41:

Number of obs	=	978
F(8, 969)	=	33.15
Prob > F	=	0.0000
R-squared	=	0.0614
Root MSE	=	.97281
Adjusted R ²	=	0.0536

TOTAL RETURNS	Coefficient	Robust std. err.	t	P> t	[95% conf. interval]	
SIZE	.069	.025	2.78	0.006	.020	.118
VALUE	-.004	.031	-0.13	0.899	-.065	.057
INVESTMENT	.205	.063	3.26	0.001	.082	.329
PROFITABILITY	-.025	.012	-2.10	0.036	-.049	-.002
OPERATING LEVERAGE	-.041	.023	-1.82	0.069	-.085	.003
FINANCIAL LEVERAGE	-.025	.040	-0.62	0.536	-.104	.054
CASH HOLDINGS	-.049	.022	-2.22	0.027	-.093	-.006
MOMENTUM	-.136	.066	-2.05	0.041	-.266	-.006
_cons	3.80e-17	.031	0.00	1.000	-.061	.061

Table 41: OLS regression results for the recovery period with robust standard errors.

In the Covid-19 the statistically significant variables are cash holdings and momentum. Based on the regression coefficients the linear relationship with total returns is negative for both cash holdings and momentum. The adjusted R-squared statistic of 0.273 is notably high for a cross-sectional regression model. Based on the F-statistic the model is statistically significant with even at the 1% risk level. The regression results for the Covid-19 are presented in Table 42:

Number of obs	=	1,016
F(8, 1007)	=	2.96
Prob > F	=	0.0028
R-squared	=	0.2792
Root MSE	=	.85238
Adjusted R ²	=	0.273

TOTAL RETURNS	Coefficient	Robust std. err.	t	P> t	[95% conf. interval]	
SIZE	.038	.027	1.39	0.164	-.016	.092
VALUE	.115	.083	1.39	0.166	-.048	.277
INVESTMENT	.009	.023	0.38	0.707	-.037	.054
PROFITABILITY	-.520	.323	-1.61	0.108	-1.155	.114
OPERATING LEVERAGE	-.015	.021	-0.70	0.483	-.056	.026
FINANCIAL LEVERAGE	-.019	.015	-1.34	0.182	-.048	.009
CASH HOLDINGS	-.049	.017	-2.99	0.003	-.082	-.017
MOMENTUM	-.108	.044	-2.48	0.013	-.193	-.023
_cons	-2.47e-16	.027	-0.00	1.000	-.052	.052

Table 42: Table x: OLS regression results for the Covid-19 with robust standard errors.

The explanatory power of operating leverage in cross-sectional analysis of returns has been examined in previous academic literature. Novy-Marx (2011) states that operating leverage predicts returns in the cross-section and that operating leverage explains the weak explanatory power of the value variable. The relationship between value and operating leverage is also examined by García-Feijóo and Jorgensen (2010). Their results imply that there is a positive association between book-to-market and the degree of operating leverage. They also state that the evolution of systematic risk associated with firm-level investment activity is likely the main determinant of the value premium. In the model used in this thesis, operating leverage had significant explanatory power in only 2 out of 5 subperiods and value

in just 1 out of 5. The results of this model are not in line with previous research, as the operating leverage does not explain total returns in most of the subperiods.

The explanatory power of momentum in cross-sectional analysis of returns has also been examined in previous academic literature. Geczy and Samonov (2016) state that price momentum is dynamically exposed to market risk, conditional on the sign and duration of the trailing market state. On average, in the beginning of positive market states, momentum's equity beta is opposite to the new market direction, which contributes negatively to momentum profits around the turning points of the market. The results imply that a dynamically hedged momentum strategy significantly outperforms the unhedged strategy. Daniel and Moskowitz (2016) identified the same phenomenon that momentum performs the worst during the turning point from an economic downturn towards economic expansion. In the model of this thesis, momentum has had a negative relationship with total returns in all subperiods, except for the ICT bubble, so the results are not in line with previous findings.

5. Conclusions

This thesis examined the key performance drivers of NYSE, NASDAQ and AMEX stocks in varying market states in the 21st century. The research focused on the characteristics of stocks that outperformed and underperformed the market during the five identified subperiods, the key performance drivers of stocks and their dependence on the market states, similarities and differences of the winners and losers in varying market states and the effects of portfolio size and the calculation method of market returns on the results of the tests.

The key performance drivers that were chosen to be examined in this research have been studied in previous academic literature and their dependence on the market states has also been previously researched. The novelty of this research stems from focusing on the characteristics of winners and losers retrospectively to gain new insights on the characteristics of the Covid-19 subperiod. Earlier research has mainly focused on backtesting investment strategies to find if some anomalistic variables are able to forecast future returns. This research aims to answer what are the anomalous drivers that are common for winners and losers, and to what extent these drivers are dependent on market states and conditions.

Question 1: *“What have been the key performance drivers of stocks in NYSE, AMEX and NASDAQ between 2000-2021?”*

The regression results show that every variable has significant explanatory power over total returns in at least one subperiod. Cash holdings and investment are significant in 4 subperiods, size and momentum in 3 subperiods, financial leverage, operating leverage and profitability are significant in 2 subperiods, and value is significant in 1 subperiod.

The investment-variable has been statistically significant in all subperiods except for the Covid-19, and it has had a positive relationship with total returns in all subperiods except for the ICT bubble. The variables value, operating leverage, financial leverage and cash holdings have a negative relationship with total returns in every subperiod where they are statistically significant. The momentum variable has a positive relationship with total returns in the ICT bubble and a negative relationship in the recovery period and the Covid-19. The size-variable has a negative relationship with total returns in the economic boom and a positive relationship in the financial crisis and the recovery period.

Question 2: *“What characteristics are specific to companies that have outperformed the market and companies that have underperformed the market?”*

The winners have on average had lower financial leverage than the losers. In market states of economic downturn, the winners have a higher operating leverage than the losers whereas in market states of economic expansion, the winners have a lower operating leverage than the losers. The winners have had lower cash holdings than the losers in all periods except in the financial crisis and the winners have had higher profitability until the recovery period.

The characteristics of winners and losers varied based on the subperiod for all variables except for the financial leverage, which was always lower among winners. The changes in characteristics were not perfectly dependent on the market states except for the operating leverage variable. In the ICT bubble winners had higher profitability, operating leverage and momentum than the losers. In the economic boom the winners had higher asset growth and profitability than the losers. In the financial crisis the winners had higher size, value, investment, operating leverage, profitability, cash holdings and momentum than the losers. In the recovery period the winners had higher size and asset growth than the losers. Whereas during the Covid-19 period every variable had smaller values in the winners than the losers.

Question 3: *“To what extent are these key drivers dependent on varying market states?”*

Based on the regression results of the statistically significant variables the asset growth effect on total returns has been dependent on the market state in the ICT bubble, the economic boom, and the recovery period. The only subperiod where this relationship does not hold is the financial crisis. In periods of economic expansion, the linear relationship has been negative, whereas in periods of economic downturn the linear relationship has been positive. Profitability has been a statistically significant explanatory variable in two subperiods, which are the financial crisis and the recovery period. In the period of economic expansion, profitability has had a negative relationship with total returns whereas in the period of economic downturn the relationship has been positive.

Since there is only one statistically significant variable out of the nine variables that has a perfect dependence on the market states when explaining total returns, the profitability-variable, the regression results do not indicate significant results on the key performance drivers being dependent on the market states. The Welch's t-test results of comparing characteristics of winners and losers in varying market states give much stronger evidence that there is a relationship between the market states and the key performance drivers. The Welch's t-test results show that winners and losers in similar market states have similar characteristics. They also indicate a pattern where winners in economic downturn as well as losers of economic expansion periods are very similar.

Question 4: *“How much of the total returns of companies are explained by the identified key drivers?”*

The adjusted R-squared statistics are usually relatively low when conducting cross-sectional regressions. This is true in this thesis for subperiods of economic boom, the financial crisis and the recovery period. Each of these subperiods have an adjusted R-squared statistic of below 0.10. By contrast the adjusted R-squareds for the subperiods of the ICT bubble, 0.289, and the Covid-19, 0.273, are remarkably higher, thereby indicating a strong explanatory power of the model.

In the ICT bubble there are five statistically significant explanatory variables so in the subperiod the collective group of variables has had more explanatory power than the other models. In the Covid-19 period there are only two statistically significant variables, implying that the two variables have had notably high explanatory power in the subperiod.

Question 5: *“Are the characteristics of companies in winner- and loser-portfolios similar in similar market states?”*

In periods of economic growth, losers have more in common with losers in other periods of economic growth than winners have in common with winners of other periods of economic growth. The inverse is true for periods of economic downturn. In these periods, the winners have more in common with winners of other periods of economic downturn than losers have in common with losers in other periods of economic downturn.

Question 6: *“Are the characteristics of companies in winner and loser portfolios different in different market states?”*

The economic boom and the recovery period have more similarity than the economic boom and the ICT bubble which implies that characteristics are different in different market states. When comparing the financial crisis to the ICT bubble and the financial crisis and the economic boom the results indicate that characteristics can be different even in similar market states. The winners and losers in the financial crisis are most similar to the winners and losers in the economic boom, as well as to the winners and losers of the Covid-19 subperiod. The winners and losers in the same subperiods were also analysed and the results show that the only subperiod, for which most of the variables were consistently different between winners and losers was the ICT bubble. All the subperiods had differences in the characteristics of winners and losers but in all subperiods except the ICT bubble, most of the

characteristics of winners and losers in the same subperiod were statistically similar with the majority of all portfolio sizes.

Question 7: *”Based on the characteristics of winners and losers, is the Covid-19 period closer to the financial crisis or the economic boom before the financial crisis?”*

When examining the characteristics of winners and losers in varying market states, a clear pattern emerges. In periods of economic growth, losers have more in common with losers in other periods of economic growth, than winners have in common with winners of other periods of economic growth. The inverse is true for periods of economic downturn. In these periods the winners have more in common with winners of other periods of economic downturn than losers have in common with losers in other periods of economic downturn. This pattern holds for all subperiods and when applying it to the winners and losers of Covid-19, all results point towards Covid-19 resembling a period of economic downturn more than a period of economic expansion.

The similarity of characteristics in Covid-19 and the financial crisis is also higher in both winners and losers than the similarity of characteristics with Covid-19 and the economic boom. The results are very interesting as based on the characteristics, the subperiod of the highest market return is the most similar to the subperiod of the lowest market return. It is although important to note that after the financial crisis, the subperiod that is the second to closest in similarity with the Covid-19 is the economic boom. In winners of the Covid-19 and the financial crisis, all characteristics, except for size and momentum, are similar with all possible portfolio sizes and all examined market returns. In losers of the Covid-19 and the economic boom the similar characteristics are value, investment, profitability and momentum.

Question 8: *“Does changing portfolio size or market returns change the results significantly?”*

The models are sensitive to changes in the portfolio size and varying it changes the results. For this reason, the figures for all possible portfolio sizes are presented and mean values of all possible portfolio-size results are calculated. Changing the calculation method of the market returns changes the market returns in all five calculation methods that were used. The market returns define the splitting point of the two portfolios, and thus defines the maximum possible portfolio size. Therefore, changing the calculation method of the market returns changes the results of the tests. For this reason, all tests that include splitting the sample into winner and loser portfolios, have been conducted with all 5 different market returns.

This research has provided novel results in multiple areas. The cross-sectional regression results show that the chosen group of variables had a strong explanatory power over total returns in the ICT bubble and the Covid-19. The comparison of characteristics of winners and losers in varying market states, the Welch's t-test results of portfolios of varying portfolio-size, market returns and market state, and examining the similarities and differences in various portfolio comparisons has brought up new research results that indicate that based on the characteristics of winners and losers, the Covid-19 period resembles a crisis more than a boom. This is the most interesting result of this research, as the Covid-19 subperiod has by far the highest market returns of any researched subperiod in the 21st century. These results can motivate further research on understanding the current state of the market better.

For further research, additional variables could be examined for potentially being key performance drivers of US stocks in the 21st century. Furthermore, additional statistical tests could be conducted on the market state of the Covid-19 period to gain a deeper understanding of the current state of the market. The research could also be expanded to new markets to compare the US results with the results from Europe and other geographical areas.

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