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Prices of the crisis

The impact of COVID-19 on stock-market performance of Finnish export companies

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ABSTRACT:

The world has faced an increasing amount of market shocks and crises in recent years, causing market turbulence. The uncertainty due to volatility has raised risks in the stock market. The outbreak of the Coronavirus pandemic caused the stock market crash around the world. The impact of the pandemic on the economy was unprecedented, it simultaneously affected supply and demand. It was assumed that the global restrictions and closure measures would depress export markets for an extended period due accumulate disruptions in supply chains.

The aim of the research is to study the impact of COVID-19 on the stock market performance of Finnish export companies and to research effects from the perspective of behavioural finance. The quantitative study is divided into four parts to examine the overall effect on the stock market performance, correlations, volatility, and the impact of news on the development of share prices. The theoretical section creates a foundation for analysing the results of the qualitative research. It incorporates literature on exports, stock market performance of export, COVID-19 and its role in trade and investment, and behavioural finance. Stock market data from the research period, 2019.01.02.– 2021.12.30. was used as data.

The most meaningful event was on week eight in 2020, after Italy had announced that a significant chain of infections was detected in Northern Italy, leading to a stock market collapse. The decline was almost correlative among markets, plummeting values an average of 30%. The fall lasted four weeks, halting in week 11, as uncertainty reached its top, and trading was levelled off to a week-long stagnation. Global announcements of corporate support packages restored investor confidence setting markets in motion and leading stock prices to rise. The extraordinary correlation between the economy and contagion events weakened over time.

The results of this master's thesis connected share correlations with negative news, such as the outbreak of new waves. Fear and uncertainty dominated market performance. It establishes that volatility was primarily due to people's reactions to the pandemic. Reversion of values overall was rapid, pointing out that long-term or permanent damage did not occur.

The research noted the emergence of a disconnect between the performance of stock markets and the real economy. The market did not function efficiently, highlighting behavioural finance's role and the assumption of irrational investor behaviour, which is influenced by psychological and behaviouristic factors. The study identified hasty generalisation, loss aversion, anchoring, confirmation, recency, and herding biases among these factors. Negative emotions were found to cause a significantly stronger reaction than positive emotions.

KEYWORDS: Behavioural finance, COVID-19, economic shock, export, foreign trade, stock-market performance

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ABSTRACT:

Maailma on kohdannut viime vuosina kasvavassa määrin markkinashokkeja sekä kriisejä, jotka ovat ravisuttaneet sijoitusmarkkinoita. Ailahtelevuudesta syntyvä epävarmuus on kasvattanut markkinariskejä. Koronaviruspandemian puhjettua pörssit syöksyivät globaalisti laskuun. Pandemian vaikutus talouteen oli ennennäkemätön, se vaikutti yhtäaikaisesti tarjontaan sekä kysyntään. Globaalien rajoitusten sekä sulkutoimenpiteiden arveltiin lamaannuttavan vientimarkkinat ja vaikutusten kestävän vielä pitkään pandemian jälkeen.

Tutkimuksen tavoitteena on tutkia suomalaisten vientiyritysten pörssikurssien kehitystä pandemian aikana sekä tutkia markkinareaktiota sijoittajapsykologian näkökulmasta. Teoriaosuus luo pohjan kvantitatiivisen tutkimuksen tulosten analysointiin. Teoria käsittelee sijoittajapsykologiaa sekä pandemian vaikutusta ulkomaankauppaan, osakemarkkinoihin ja Suomen vientiin. Aineistona on käytetty aikaisempia tutkimuksia, vakiintuneita teorioita, virallisia raportteja sekä tilastoja. Kvantitatiivinen tutkimus koostuu neljästä erillisestä tutkimuksesta, jotka tutkivat yleisvaikutusta, korrelaatioita, volatiliteettia sekä uutisten vaikutusta osakkeiden hintojen kehitykseen. Aineistona käytettiin pörssidataa tutkimusjakson ajalta, 2.1.2019-30.12.2021.

Tämän pro-gradun tulokset osoittavat, että pandemialla oli selkeä vaikutus vientiyritysten osakkeiden hintakehitykseen. Merkittävin tapahtuma ajoittui viikolle kahdeksan vuonna 2020, kun Italia oli ilmoittanut laajasta tartuntaketjusta. Pörssikurssit ajautuivat korreloivaan pudotukseen, menettäen keskimäärin 30 % arvoistaan. Lasku jatkui kuukauden ja pysähtyi vasta viikolla 11, kun epävarmuus saavutti huippunsa ja kaupankäynti taantui viikon mittaiseen stagnaatioon. Globaalisti ajoitetut ilmoitukset yritysten tukipaketeista palauttivat sijoittajien uskon johtaen kaupankäynnin jatkumiseen ja pörssikurssien nousuun. Osakkeiden välinen poikkeuksellinen korrelaatio jatkui hiipuen tutkimusjakson loppua kohden. Korrelaatiota selittävät negatiiviset uutiset, kuten uusien aaltojen puhkeaminen, jotka saivat markkinat kollektiivisesti varautumaan vastaavaan pudotukseen kuin marraskuussa. Pelko ja epävarmuus hallitsivat hintakehitystä, mutta korrelaatio talouden ja tartuntatapahtumien välillä heikkeni ajan kuluessa. Tutkimus osoittaa, että osakkeiden hintavaihtelu johtui enimmäkseen ihmisten reaktiosta pandemiaan. Arvojen palautuminen oli nopeaa, ylittäen pandemiaa edeltäneet huippunsa osoittaen, ettei pitkäaikaista tai pysyvää haittaa syntynyt. Pörssikurssit olivat irtaantuneita todellisesta arvosta, eivätkä markkinat toimineet tehokkaasti. Vahvistaen käyttäytymistieteellisen rahoituksen oletusta sijoittajien irrationaalisesta käyttäytymisestä, johon vaikuttavat psykologiset ja behavioristiset tekijät. Tutkimus tunnisti näistä tekijöistä liiallisen yleistämisen, tappiokammon, ankkuroinnin, vahvistusharhan sekä lauma-ajattelun vaikutuksen hintojenkehitykseen. Negatiivisten tunteiden todettiin johtavan huomattavasti vahvempaan reaktioon kuin positiivisten.

KEYWORDS: Behavioural finance, COVID-19, economic shock, export, foreign trade, stock-market performance

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Abbreviations

BBC	The British Broadcasting Corporation
CEO	A chief executive officer
CNN	The Cable News Network
COVID-19	Coronavirus disease 2019
EK	Elinkeinoelämän keskusliitto
GDP	Gross domestic product
HS	Helsingin Sanomat
ICT	Information and Communications Technology
ITA	International Trade Administration
MERS	Middle East Respiratory Syndrome
NBER	National Bureau of Economic Research
OECD	Organisation for Economic Co-operation and Development
OPEC	The Organization of the Petroleum Exporting Countries
R&D	Research and development
SARS	Severe acute respiratory syndrome
STHDA	Statistical tools for high-throughput data analysis
TS	Turun Sanomat
UNCTAD	United Nations Conference on Trade and Development
WHO	World Health Organization
WTO	World Trade Organization
YLE	Yleisradio Oy

1 Introduction

This chapter introduces the background and content of this thesis. It offers a foundation for the research gap and presents this research's objectives and research questions. After that, the delimitations, and reasons behind them are introduced. In addition, to offer readers a better understanding, some key concepts are explained, and at the end of this chapter, the structure of this thesis is described.

1.1 Background

The corona pandemic is one of the largest global crises of recent times, and the amount of research related to it is constantly increasing. This thesis focuses on how the pandemic affected Finnish export companies and foreign trade. The impact is examined especially from the investor's point of view. At present, we have extensive statistical information about the effects of the pandemic on Finnish export markets. However, the information is scattered, and the subject has not been researched from this angle. Therefore, gathering, and cross analysing the data collected with share prices is meaningful. In this way, the investor can better assess the risks related to foreign trade in crises.

In 2020 the COVID-19 pandemic had a severe and versatile impact on international trade, supply, and demand. According to OECD (2022), impact and changes in trade flows were heterogeneous across products, sources, and destinations, which meant high uncertainty and adjustment costs, forcing companies and governments to adopt new risk mitigation strategies. Sudden disturbance followed in stock markets, causing historical volatility across industries (Baek et al., 2020, p. 2). The Economist (2020) argued that there was a dangerous gap between the markets and the real economy. Baldwin and Weder di Mauro (2020, p. 13) suggest that the negative impact is not necessarily due to the virus itself, it is the human reaction to the virus.

The hypothesis of the efficient markets argues that markets reflect all available information. When there is uncertainty about the future, investors must create their own forecasts and buy or sell based on that. (Malkiel et al., 1970, p. 383) In turn, the fundamental approach to stock valuation (Graham & Dodd, 1934) states that the price of a share should depend on expectations about the amount of cash that a company will generate in the future, adjusted for the expected return rate by investors. Nevertheless, the evidence of economic research also recognises over-reaction, under-reaction, momentum, and bubbles in share prices (De Bondt & Thaler, 1985, p. 793; Jegadeesh & Titman, 1993, p. 65; Greenwood et al., 2019, p. 20).

According to De Bondt and Thaler (1985, p. 793), changes in share prices are abrupt when crises occur but initially tend to follow known patterns regardless of the sector. Therefore, this study examines changes from the perspective of both a long-term and a short-term investor. Understanding investor behaviour in stock markets is especially important for pre-investors. For a short-term investor, the volatility that follows crises offers an opportunity to turn the crisis into profit. From the point of view of a long-term investor, it is important to understand the time it takes for the share prices to reach a balance and the factors leading to it. Overall, high volatility during a crisis can be expected. Still, it is useful to know the magnitude of such changes and recognise the difference between the early and later stages of the crisis.

1.2 Research question and objectives of the study

The preceding discussion steers the course of the present thesis. The primary objective of this thesis is to investigate the impact of COVID-19 on the stock market performance of Finnish export companies. Accordingly, the main research question is:

What is the impact of COVID-19 on the stock market performance of Finnish export companies?

The main research question is approached and addressed by the following two sub-questions:

1) ***How did this crisis affect the stock prices of Finland's ten biggest export companies?***
2) ***Can the effects be explained by behavioural finance?***

In order to answer the research question and achieve the objective, this thesis has four sub-objectives. These objectives are:

1) *To study conceptualisation, types, motives, and stock market performance of export.*
2) *To increase understanding of the characteristics and overall role of COVID-19 in trade and investment.*
3) *To empirically explore the impact of COVID-19 on the stock market performance of the ten biggest export companies from Finland.*
4) *To explain the above-mentioned impact from the perspective of behavioural finance.*

Findings will increase understanding of investor behaviour during COVID-19, intending to find a correlation between stock market movements and investors' behaviour since it cannot be directly observed or measured. Further, by studying the financial data of Finnish export companies, it can be concluded how well companies are prepared for disruptions in global supply chains and how promptly they can relaunch their regular operation. The data is used to calculate stock volatility, creating graphs to deduce what is the crisis impact and examine relations to investor behaviour by paralleling data with news and well-established theories. Companies stock values are examined by correlation analysis and OMX Helsinki 25 index (henceforth, OMXH25 index) is used as a benchmark to deduce if market behaviour among export companies differs from common. This is noteworthy due to the nature of COVID-19. The effect and uncertainty should be highest in sectors where external factors impact business more, like in export markets (Arriola et al., 2021, p. 5).

Export companies were designated as the subject of the study as their share of Finland's gross domestic product is more than a third, which indicates that the impact on the stock market is significant. Due to the nature of the pandemic, the effects on exports are further multidimensional than in other sectors. Lockdown measures and quarantines worldwide caused a multiplier effect on the movement of goods, slowing down deliveries and manufacturing because it was not feasible to obtain raw materials as in a stable market situation. Due to Finland's remote location, the functionality of supply chains significantly impacts export companies' operations.

This thesis advances the prior knowledge of the subject by researching relative influence and widening the research scope on times before and after the COVID-19 shock. It also analyses significantly more detailed effects of researching individual companies on a daily level and offers country-specific data. As previous studies benefits institutions by measuring averages and overall effect, this research contributes to individual investors and companies. Also, as export constitutes a third of Finland’s GDP, thus being vital for the overall economy. Knowing how export companies react in a crisis and what affects them is helpful in future scenarios. From the viewpoint of behavioural finance and benefiting it, a large amount of study from various situations and contexts is needed for research otherwise relatable immeasurable investors’ behaviour.

1.3 Delimitations of the study

This thesis aims to research the impact of COVID-19 the on the stock market performance of Finnish export companies and research the correlation between market behaviour and share prices. Therefore, external factors affecting individual companies' financial situation will be delimited. This includes, inter alia, direct company-specific financial aid granted by the government, interest rates, prices of raw materials, and rising energy costs. It also does not consider regional differences regarding the duration and scope of closing measures caused by the pandemic. Because of this thesis explores unprecedented phenomena, which collectively affected global economics in multiple ways,

causing supply and demand shock in a way never experienced before. It does not directly base on existing theories but uses them as guidelines. The biggest Finnish export companies were chosen because they comprise a large part of Finland's gross domestic product, affecting the whole country (The World Bank, 2021). Due to these companies' wide customer base around the globe, the results will not get distorted if specific continents or countries would be blocked from export due to restrictions.

The time period 2019-2022 was chosen since it includes one-year control groups in both ways, before and after COVID-19, and one year with COVID-19. Limiting control groups to one year was essential because a wider time period would also include other crises. Data of the study concentrates on historical values, therefore any estimations of future development will be delimited. Closing prices were chosen as a measurement since it is widely used in such research, a standard and considered the most accurate option. (Harris, 1991; Stockopedia, 2022; Yan, 2022) The behavioural viewpoint was chosen since it is crucial to understanding market movement under exceptional circumstances such as COVID-19. When the stock market was historically volatile and unpredictable for traditional finance models, investors were influenced by non-financial factors such as fear and uncertainty, basic aspects of behavioural finance. Hence these behavioural aspects were visible during COVID-19, it was a natural theory to choose.

1.4 Definitions of key terms

Behavioural finance: As a subfield of behavioural economics, behavioural finance studies the influence of psychology and psychological biases that impact investors' decisions and market outcomes. Irrational, emotional behaviour could explain stock market anomalies, such as intense rises or declines in stock prices, which cannot be explained by rational theories such as the efficient market theory. (Shiller, 1990, p. 58–59)

COVID-19: A new type of disease caused by a coronavirus, it had not circulated among humans before 2019, which after it quickly spread around the globe, causing a global

pandemic. A virus causes respiratory infections, and the incubation period from infection to the onset of symptoms or further contagiousness varies from one to fourteen days. A small proportion of those infected has a serious infection that leads to hospitalisation. World Health Organisation declared the coronavirus epidemic as a pandemic on March 11, 2020. According to the WHO, worldwide mortality has been 1.1% since the beginning of the epidemic. (Anttila, 2022)

Economic shock: Refer to unforeseen events that can have either a positive or negative impact on an economy. These exogenous factors are unpredictable and can affect endogenous economic variables, which are essentially the factors within the scope of economic models. In short, external factors can have a significant impact on the economy beyond what economic models can account for. (Reed, 2020)

Export: Oxford Reference (n.d.) describes it as an act of selling goods and services to another country that those were produced in. Companies deliberately seek out foreign markets worldwide for business, providing additional revenue and transactional prospects, as opposed to limiting themselves within their geographic boundaries.

Stock market performance: The ability of a stock to grow or reduce the wealth of its shareholders is measured by stock performance. Performance is often gauged by how much the price changes. A rising stock price indicates strong performance for the stock. In turn, a price decline indicates a weak performance. The performance of stocks varies depending on the industry, price, and stability. (Capozzi, 2023)

1.5 Previous key studies

COVID-19 have wildly aroused interest among researchers across fields. It was an event that shook and affected everyone. In the field of economy, previous studies have concentrated on researching shorter periods. Otherwise, research covers economic effects in a wide range. This thesis increases the research period and aims to provide new

information for the investors, it also reviews and summarises known influence and specifies investor behaviour.

Increasing research from various views and specifying existing data is significant hence that we can acquire as much knowledge as possible from this crisis and be prepared for future scenarios. Scientists have long warned of such events as COVID-19, which was undoubtedly the first time that strict lockdowns, mobility restrictions and quarantines were simultaneously experienced worldwide. Nevertheless, according to statistics, the probability of such events is only going to rise, analysis by Marani et al. (2021, pp. 1–2) remarks that the probability of a similar impact is about two percent in any given year, meaning the probability of experiencing similar pandemic as COVID-19 in one's lifetime is round 38 percents. As a result of global warming, animal habitats are altering and bringing animals more contact with people, increasing the risk of zoonotic diseases and changing the spreading dynamics of mosquito-borne diseases. Climate change has aggravated over half of the infectious diseases. (Mora, et al. 2022) Jacob Lemieux, Harvard Medical School assistant professor of medicine at Massachusetts General Hospital, remarks, "*We are seeing pandemics emerge frequently, not once in a lifetime, but in fact every few years, and we need to start preparing"* (2022, p. 869).

In previous studies, Ramelli and Wagner (2020, pp. 622–655) studied stock price reactions across industries and how real shocks and financial policies drive firm value. They were pioneers in analysing COVID-19 effects on periods. They discovered that mainly internationally orientated companies that exposed trade with China should have performed better. Richard Baldwin and Beatrice Weder di Mauro (2020) examined the overall effect of COVID-19 on economics, they aimed to forecast the effects and explored the harm already caused by the crisis. They researched economic contagion, spread, damage, and duration of economic impacts, aiming to offer solutions for government actions. Naveed et al. (2022) approached the subject from the view of investor psychology. They investigated the influence of psychological biases on the investment decisions of Chinese investors in the post-COVID-19 era. The results indicate that several biases affected

investors' behaviour. Several other research and findings of them, as well as a more detailed view of these research, will be referred to in this thesis.

1.6 Structure of the thesis

The first chapter of this study presents the background of the thesis topic. It introduces the research question and sub-objectives, disclosing the aim of this research. As well as delimitations and reasons behind them are presented. Next key terms are listed, which ensures mutual understanding of their meaning so that research is understood in the way the author has meant and helps to understand unfamiliar terms. As last, before the structure, previous key studies and results are presented shortly.

The second chapter is a theoretical literature review comprising a comprehensive overview of main subjects such as exports and COVID-19. Then proceed to research literature and studies of how those subjects are related, their role in finance, and their meaning to investor behaviour. The subjects are observed on a country and global scale.

After the literature review, choices for quantitative study are explained and reasoned. Then proceeding to data collection, limitations and sample, following data analysis along with used programs and tests are introduced. As last, the reliability of the research is analysed.

The fourth chapter presents empirical results. The research included four sub-research that investigated the same event from individual perspectives. The same data was used on each of them. The research includes overall effect, correlation, volatility and stocks' response to the news. As last, investor behaviours' impact on the market is discussed.
The last chapter of the thesis consists of the research's conclusions and summary. The results of sub-researchers are combined, and the theoretical part is used for interpreting the results. In the last, suggestions for future research are suggested.

2 Literature review

This literature review presents the main theories and concepts of the field. It provides a broader view of the topic and benefits readers in internalising the topic under study, and to better understand the quantitative research performed. This chapter also answers to sub-objectives of the thesis. Concepts and theories are presented so that readers without experience of financial markets nor familiar with financial lingo can effortlessly understand the subject and follow this thesis.

2.1 Export and stock market performance

The exchange of goods and services across international borders is referred to as international trade (Oxford Reference, n.d.). According to research by Rakesh (2014, p. 21), exports constitute a significant part of the gross domestic product in most countries. He notes that when free trade became widespread, there was a significant expansion in international trade; in related, export is the sale of goods or services abroad, and import is the corresponding purchase from abroad. The balance of payments, which is the most critical component of the balance of trade, is determined based on exports and imports in national accounting (Stat, n.d.). The World Trade Organization, as an international umbrella organisation negotiates regulations governing trade between countries (WTO, n.d.).

The main motives for exports are expansion into a global market, increasing customer base, higher profits, and increased product life cycle (International Trade Administration, n.d.). The two main types of exporting are direct exporting and indirect exporting. Direct exporting involves a corporation selling its goods directly to customers abroad, and indirect exporting is carried out by businesses that sell goods to other nations through an intermediary (Oxford References, n.d.).

Though, when a company begins exporting, it will face a rising number of risks and variables that affect its stock performance, which is a measure of the returns on shares over a period of time. In general, there are countless contributing factors to cause share price fluctuation, but related to export companies, events such as COVID-19 may cause unexpected difficulties, making their stock performance more volatile equated to domestic ones.

As discussed, several factors affect share prices in general. Since risks and variables are higher in export companies, several academics have suggested that COVID-19 created trade barriers that negatively affected exports, leading to poor stock market performance. Duan et al. (2020, p. 515) highlighted that the pandemic severely affected more than 18 million SMEs in China, the majority of whom relied heavily on exports. According to Baldwin and Weder Di Mauro (2020, pp. 20, 67), the pandemic has had a significant impact on both the economy and the environment, with border and factory closures being major contributors. Di Mauro (2020) suggests that this impact is greater than any other pandemic since World War II. It resulted in a significant decline in export market performance from the related industries in the countries where the pandemic occurred.

2.1.1 Finland’s export

Foreign trade has always been important to Finland, this has been emphasised in the recessions and boom of the economy. As a small and open economy, fluctuations in imports and exports have shaped the national economy's major development guidelines (Suomen Pankki, 2007). Export companies operate in the field of foreign trade, which refers to trade in goods and services between different countries (Oxford Reference, n.d.). According to the Statistic Finland (2021), the share of exports constitutes a large part of Finland’s gross domestic product. In 2021, the share of exports of gross domestic product exports was 39 percent, as can be seen in Table 1, which describes percentages between 1970–2021. X-axis indicates the year, and Y-axis percentages.

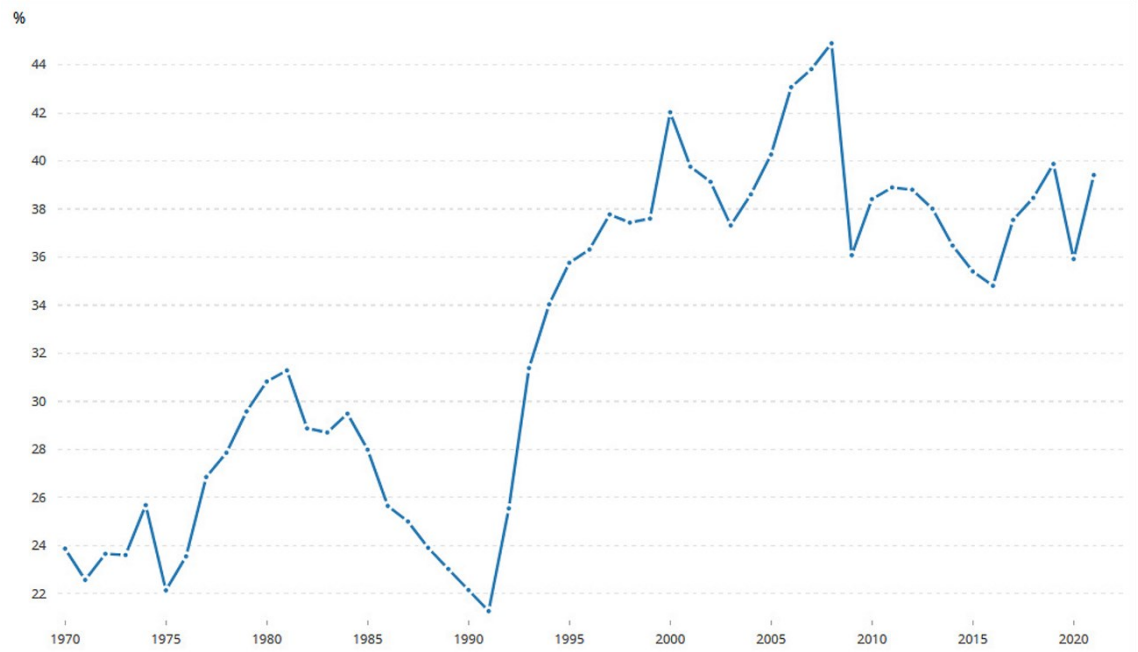

Figure 1. Finland's exports of goods and services % of GDP (TWD, 2021).

Between 1992–1997 the share of exports increased yearly, totalling a 15.5 percentage increase. It can be explained by industrial production, which started to grow in 1992, Finland's joining the European Union in 1995, and becoming a member of the European Economic and Monetary Union in 1998 (Tilastokeskus, 2007). General development of world trade was also rising rapidly at that time, benefitting Finland's export.

Due to the nature of foreign trade, the direct and indirect effects of even a short crisis tend to be far-reaching, this is reflected in Figure 1 as steep declines. In 2009 due to the financial crisis, the export of goods and services shrank by a fifth, and the export figures returned to their previous level only in 2018 (TWD, 2021).

As companies internationalise, an increasingly large part of foreign trade is business to business (EK, 2022). Success in the export markets requires competitive products. Still, it is also highly dependent on demand which is influenced by the world economy's growth rate and the market's functionality.

Figure 2. Finland's export of goods, quarterly, 2019–2021 (Statistic Finland, 2022).

As presented in the diagram above, Figure 2, due to the COVID-19 pandemic and related restrictions, the value of Finland's foreign trade decreased by 11 percent in 2020 from the previous year, after that in 2021, exports turned to the growth of 16 percent, turning the ratio of exports to gross domestic product to 39 percent. The difficulties suffered with the export of goods were partly covered by the export of services (Suomen Pankki, 2007). When comparing the recovery of goods and services, exports of goods recovered faster, and in 2021 the value of all exports share of goods was 72 percent.

According to Statistic Finland (2022), exports have changed in the same way as the structure of industrial production. Even in the 1960s, most exports were products of the forest industry, despite the decline since the forest industry is still a significant export sector today. The forest industry's export share in 2021 was around 19%, as the paper industry's share was 13.5% and the wood industry's share was 5.5%.

The mobile phone business, which was once a foundation of Finnish export, is completely lost on that scale it was. As the export of electricity and electronics is lower than

in the peak years, the sector's share of goods exports is around 13% (Statistic Finland, 2022).

According to statistics of Statistic Finland (2022), in 2021, the export value of oil products increased by approximately 7.5% and Finland was the 31st most significant exporter of refined petroleum globally. Chemical industry products covered 18% of exports. A large part of goods exports is various metal industry products, for example, machines, equipment, metals, metal products, and vehicles. Investment goods accounted for 24% of exports in 2021. Raw materials and production goods accounted for about half of the exports. The share of consumer goods, including food and vehicles, was about 16% and energy products about 7%.

Figure 3. Finland's export of goods by region, 2020. (Finnish Customs, 2021)

The total value of exports in 2020 was 57.3 billion euros, which was -12% compared to 2019, a year before COVID-19. As seen in Figure 3, exports were concentrated in EU countries and Europe. Compared to 2019, exports to Asia decreased by 13 percent and

seven percent to other countries. North America was the only region where exports increased by two percent.

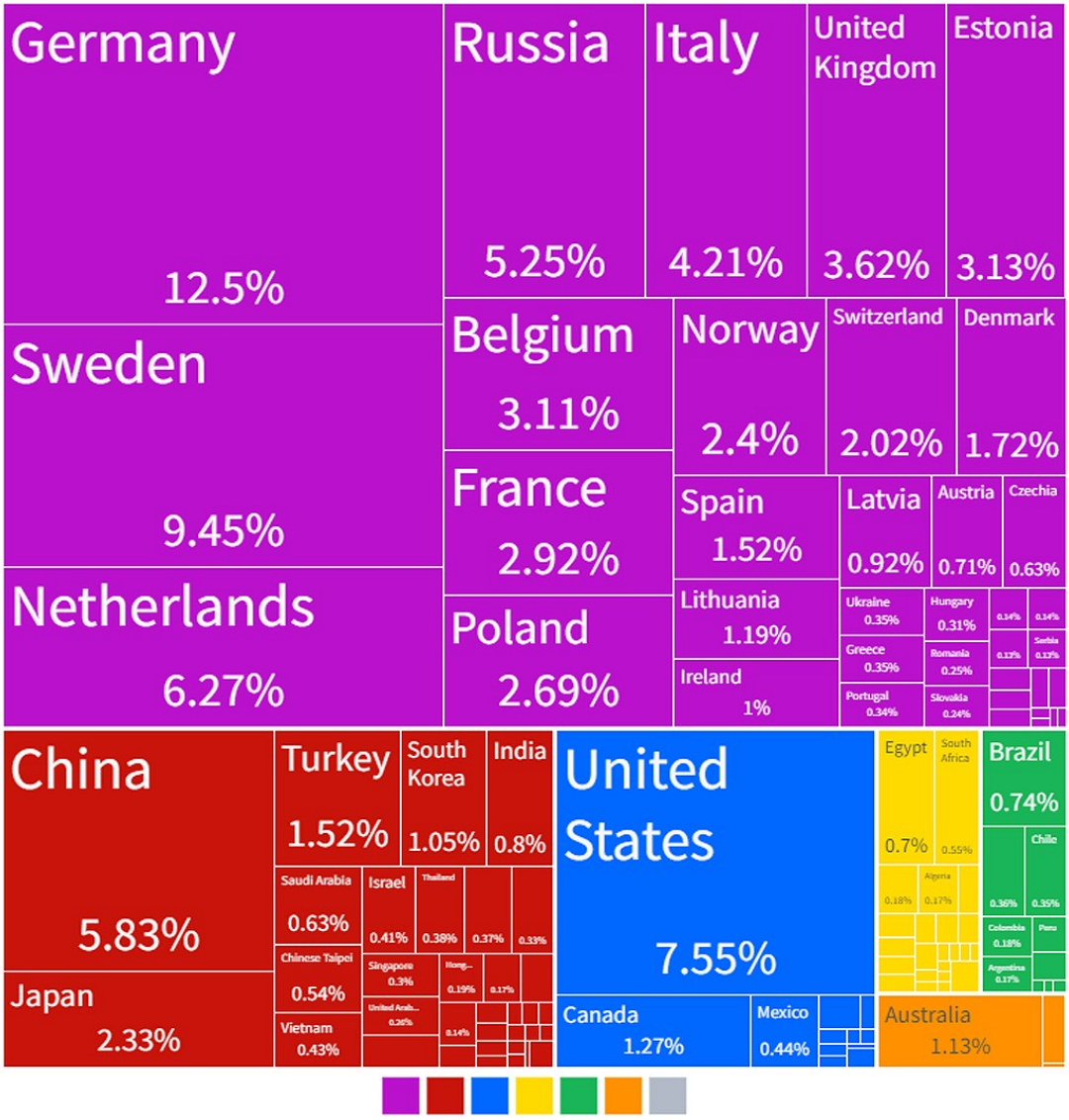

Figure 4. Finland's export of goods by region, 2021 (OECD, 2022).

Figure 4 (OECD, 2022) presents a more detailed and proportional view of destination countries in 2021. Colours represent regions; purple is Europe, red is Asia, blue is USA, yellow is Africa, green is South America, orange is Osenia, and grey is Antarctica - more specifically, French South Africa Territory, which export value was only $40.5 thousand, thus is not visible in the figure.

Europe was the biggest export region, China the second largest and the USA third. Europe's total share was 63%, and the euro areas was 40%. The most important export countries are Germany, which covers 12.5% of total export, Sweden 9.45%, the United States 7.55%, the Netherlands 6.27%, China 5.83%, and Russia 5.25%. Exports to Russia grew by 22.4%.

The fastest-growing export markets were Italy at +108%, Germany at 18.2%, and Sweden at 20.4%. Increased export to Italy was due COVID-19 related categories such as medical instruments and chemical products. (OECD, 2022a) By value, Finland was 43—exporter in the world. Exports were led by refined petroleum, kaolin-coated paper, cars, sawn wood, and large flat-rolled stainless steel. (Finnish Customs, 2022; Eurostat, 2022)

In summary, Finland depends on the global economy because exports are third of the country's GDP. Finland advocates free trade policies and is now under the European Union trade policy. The country's main export industry is forestry, and its products are paper and cardboard. Other significant export sectors are petroleum, chemicals, electronics, machinery, and transportation. (ITA, 2022b) The leading export countries over time are Germany, Sweden, Russia, and the Netherlands. China and the USA are growing export markets (Stat, 2021). The European Union covers 65% of the total trade, and approximately half of the total export is raw materials and production goods. In 2021 export portion of GDP was 38% totalling 68.6 billion euros. (EK, 2022)

The companies researched in this thesis export around the globe and present a large part of Finnish exports. Thus, the above-presented figures are essential to understand how COVID-19 may have affected their business and how those effects could affect the Finnish economy.

2.2 COVID-19 and its role in trade and investment

In their publication, *Economics in the Time of COVID-19*, Baldwin and Weder Di Mauro (2020, pp. 12–17) state that COVID-19 had three facets, affecting the economy through three simultaneous shocks, medical shock, economic shock, and expectations shock. Baldwin further investigated how these affected the flow of income. The first two shocks damaged the economy by first pushing workers out of the workforce due to medical shock, leading to widespread economic shock due to containment and restriction measures, further creating trade barriers. The third, a shock of expectations introduced a behavioural factor when customers and companies felt uncertain about the future, leading them to postpone trades to see what would occur next.

2.2.1 Event and characteristics of COVID-19

WHO's report from 2021 contains a timeline of key events of the COVID-19 outbreak, this timeline is presented in Figure 5. According to it, several healthcare facilities in Wuhan, China, reported clusters of individuals with pneumonia of unknown origin in late December 2019. These patients displayed viral pneumonia symptoms, including fever, coughing and chest pain. And in more severe cases, dyspnea and bilateral lung infiltration similar to SARS and MERS. The pneumonia outbreak with an unknown etymology was announced to the public and to the WHO on December 31. 2019 in Wuhan. The virus quickly spread widely to all of China's 34 provinces. A rapid rise in confirmed cases was seen with thousands of new cases being identified daily by late January 2020. On January 30, the World Health Organization declared the recent outbreak of coronavirus a global public health emergency. The disease was named COVID-19, and the new coronavirus was named "SARS-CoV-2" by the International Committee on Taxonomy of Viruses on February 11. 2020. (Nature Microbiology, 2020)

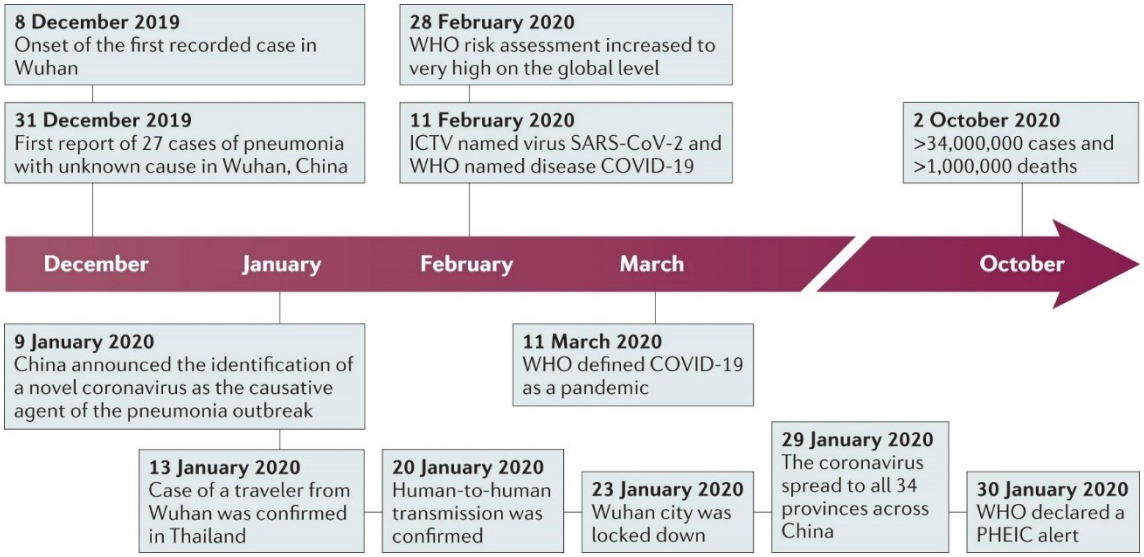

Figure 5. Timeline of the key events of the COVID-19 outbreak (WHO, 2021).

Early in 2020, Italy became the first nation to impose a nationwide lockdown after becoming the first European nation to face a significant outbreak (WHO, 2020). The World Health Organization designated Europe as the pandemic's epicentre on March 13, 2020. Lockdowns were implemented in Europe on March 18th, 2020, and more than 250 million individuals were affected. (Saglietto et al., 2020, pp. 1110–1111) Despite the release of COVID-19 vaccines, Europe became the epidemic's epicentre again in late 2021 (Reuters, 2021).

2.2.2 General role of COVID-19 in world trade and investment

An economic crisis usually starts with the shock caused by a sudden decrease in a financial asset's nominal value. The corona pandemic and the restriction measures affected both demand of products and services and the supply and demand of labour simultaneously, making the shock different from previous economic shocks (Rio-Chanona, 2020, p. 95).

Nordea Funds statistics (2022) pinpoint that the stock market reacted strongly to the pandemic, and the Dow Jones index began to decline on February 12th, 2020, the S&P

500, which illustrates the market of large US companies, declined shortly afterwards on February 19th. The Dow Jones reached its previous peak readings on November 16th, the S&P 500 on August 18th, and the technology-focused Nasdaq index on June 8th. The bottom readings were reached on March 23rd when the Dow Jones had fallen by 37 percent. Following that, international stock prices rose rapidly.

UNCTAD (2022a, p. 14) report reveals that the pandemic also substantially impacted foreign direct investment, affecting investments worldwide and in all industries. Foreign direct investments declined steeply at the pandemic's start, amounting to less than one trillion US dollars in 2020, although a V-shaped recovery was worldwide. In 2021 direct foreign investments were 1.58 trillion US dollars, a 64% increase compared to 2020.

The impact was also inconsistent in different countries economies. Santacreu et al. (2021, p. 88) suggested that the variable was how extensive the restrictions were and how severe the pandemic was. Furthermore, the support measures of different countries were partly different and of various sizes, which moderated impact. In addition to restrictions and support measures, the countries' industrial structures affected the strength of the economic impact.

For instance, the Finland pandemic significantly decreased the service industry's production and employment but had a lesser impact on manufacturing industries. Even though the service industry effects were asymmetric as the demand for various digital services increased due to remote work, but tourism and catering services shrunk notably. As a result of the pandemic, many companies' businesses decreased, causing layoffs, and reducing the workforce. (Isotalo et al., 2022, pp. 37–40)

2.2.2.1 Economic Shock of Coronavirus in export markets

The pandemic's restrictions and mitigation measures caused an increase in transaction costs across the global economy, leading to diverse economic patterns worldwide. The

two years of the pandemic had an enormous effect on international trade. (OECD, 2022b) The effect of economic shock is significant and interesting because of its swiftness, intensity, and quick rebound. Compared to the recent economic crises, the downturn in global trade during the COVID-19 pandemic in 2020 was close to the financial crisis of 2008–2009 and worse than the recession in 2015. (UNCTAD, 2021b, p. 6)

International trade was not only affected by the generalised decline in global trade but was also enchanted due to cross-border restrictions and logistic disruptions, such as closed ports. Overall, global trade declined by 2.5 trillion US dollars in 2020, meaning a nine percent downturn compared to 2019 (Georgieva, 2020).

Figure 6. Global trade trends and nowcast (UNCTAD, 2022b, p.2).

Figure 6 illustrates the global trade of goods and services. Global trade statistics cover substantial differences in trade across economic sectors. A large part of the effects on international trade flows depends on changes in demand patterns. The most drastic decline can be seen in the second quarter of 2020. Lockdowns caused a decline in demand in most sectors in the first half of 2020. (UNCTAD, 2020a, p. 27) Nevertheless, trade in essential products such as food supplies was significantly more stable, tells the report from UNCTAD (2022a, p. 7). On the opposite, trade in essential goods for mitigating the effect of the pandemic increased, this included pharmaceuticals, medical equipment's,

and personal protective items. Due to the lockdown measures, a similar increase in demand was in categories such as home office and fitness equipment.

Adaption, successful mitigation measures and the availability of vaccines led to a recovery in global demand in 2021. In the first half of 2021 the value of global trade was significantly higher than in the Pre-Pandemic era in every sector except the energy sector.

The diverse effect is also seen in country groupings based on gross domestic product per capita, in 2020 export rates decreased at the same pace across countries, regardless of gross domestic product per capita. Although exports from developing countries recovered slower in 2021, implying a decline in competitiveness (UNCTAD, 2021a).

A noteworthy outcome of the pandemic is that it has reinforced China's position as a leader in global manufacturing exports. China's export levels recovered faster than in most countries, by the second quarter of 2020, exports from China were over the Pre-Pandemic levels and have been increasing since. The export growth was mainly due to successful mitigation strategies at the beginning of the pandemic, which made it possible to reopen the supply chains ahead of the other countries and orientate manufacturing to those categories that the rest of the world needed most. As a result of this, China's global market share rose more than two percent increasing China's importance as a global importer. (UNCTAD, 2021b, pp. 11–12)

2.2.3 Explaining the role of COVID-19 in stock market trade from behavioural finance

The outbreak of the COVID-19 pandemic shook the global economy and financial markets given that there was uncertainty about the effects and the length of anomaly. (Statista, 2022a) The volatility caused by the crisis affected investors' behaviour and perceptions, and the most important stock market indexes fell significantly. Uncertainty tends to trigger investors to sell their shares and postpone their investment plans to the future.

(Statista, 2022b) Behavioural finance seeks to explain this and other irrational acts of investors.

2.2.3.1 Behavioural Finance

Baldwin (2020, p. 12) argued that the third facet of the COVID-19 shock was related to behavioural finance. Behavioural finance is a rapidly growing field that is increasingly important in today's financial markets. As traditional finance is based on fundamental ideas that investors make rational decisions and are unbiased about their future predictions, behavioural finance argues against these. (Nofsinger, 2018, pp. 1–2)

The definition originated in the 1970s–1980s when psychologist Daniel Kahneman with Amos Tversky and economist Robert J. Shiller started to challenge the consistency of the efficient market model. Behavioural finance proposes that psychological influences and biases affect investors and financial markets, it argues that some economic phenomena can be better understood using models that are not entirely rational.

Theoretical papers in the field show that irrationality can significantly impact prices when rational and irrational traders interact. (Barberis & Thaler, 2002, pp. 11–12) The literature (Subrahmanyam, 2007, p. 12) has concluded that traditional finance is limited in understanding why investors trade, how they perform, choose their stocks, and the reasons for varying returns expect than risk. Therefore, behavioural finance aims to answer these questions that traditional finance models cannot answer.

The importance of the field is highlighted in sudden and significant market shocks, especially in financial bubbles given that they are often outcomings of investor biases formed by emotions influencing the decisions made. These emotions can lead to irrational investment decisions leading to unwanted results. Therefore, understanding the flaws of investors' judgment is essential to further understand the financial anomalies. (Kapoor & Prosad, 2017, p. 50). In terms of behavioural finance studies, the impact of

psychological biases on investment decisions (Antony, 2019, p. 20), since investors are influenced by many of these biases in a practical situation, making their behaviour irrational (Thaler & Ganser, 2015, p. 230).

The influence and importance of a certain bias depend on circumstances and time, for example, overconfidence bias is particularly related to financial crises (Jlassi, et al., 2013, p. 129). Chandra and Thenmozhi (2017) introduced these biases in their book *Behavioural Asset Pricing: Review and Synthesis*. Certain of these were chosen for this thesis literature part as various sources (Naveed et al., 2022; Gharbi, 2022) have associated these biases with investor behaviour during COVID-19. By understanding these biases, investors can improve their decision-making processes.

2.2.3.2 Investor biases

Behavioural biases are often divided into two groups, cognitive and emotional biases. Cognitive biases include among others, anchoring, confirmation, and recency biases. Emotional biases include e.g., familiarity bias, loss aversion, regret aversion and overconfidence.

Cognitive biases commonly rely on preconceived notions when making decisions, even if they are inaccurate. Anchoring bias is related to comparing stock prices during the decision-making process. Investors with anchoring bias determine the price when selling and buying shares based on previous, probably on outdated information. (Waweru et al., 2014, p. 26) Thus, investors who choose to sell their stocks during a period of decreased prices may fall short with timing. In addition, an investor might lose an opportunity because their anchored price is not reached. Investors are found to be optimistic about rising prices and pessimistic about decreasing prices (Huisman et al., 2012, p. 69).

Research by Chandra & Thenmozi (2017, pp. 20–25) includes a wide section of knowledge about biases. They have stated that confirmation bias is a tendency to find

and concentrate on information that supports what investor believes and ignores the information that contradicts these beliefs. This bias may lead investors to cling to biased notions about their investments while rejecting information that disproves those ideas, investors may only note good news and ignore bad news about their investments. As the last, recency bias in investing occurs when investors value recent events. As an example, investors may expect a recent market crash to continue, which refrains them from investing and deviating from their financial goals.

Emotional biases occur spontaneously based on the investor's feelings, they are usually rooted in the psychology of investors, and these emotional biases are more challenging to overcome than cognitive biases. (Chandra & Thenmozi, 2017, p. 22)

Loss aversion is a tendency where an investor fear making a loss, and instead of concentrating on making a profit, they focus on avoiding losses. It can be seen as investing in low-return investments instead of more promising, higher-risk assets. (Chandra & Thenmozi, 2017, p. 21)

Overconfidence bias occurs when investors overestimate their capabilities, accuracy, and cognitive aptitudes of knowledge and underrates future anomalies. Investors with overconfidence assume that their prediction is more relevant than other investors' analysis and overreact to market information. (Huisman et al., 2012, pp. 70–71) Overconfidence bias is more common among male investors than females, leading them to trade excessively, resulting in fewer profits (Statista, 2022g). According to Zaidi and Tauni (2022, p. 730), previous investment experience reinforced overconfident behaviour.

Herding bias refers to the tendency of investors to follow and copy other investors. They are primarily influenced by instincts and emotions rather than their analysis. Familiarity bias is defined as the tendency for investors to prefer what is familiar rather than exploring international investments that are more complex to research and monitor. It prejudices investors against the unknown and keeps their focus narrow. In the book, *The*

Intelligent Investor (1949), Benjamin Graham explains the primary cause of the familiarity bias. In his opinion, the deadliest opponent of an investor is usually an investor himself. When making their financial selections, traders and investors occasionally do not want assistance since it is considered a sign of fragility. Another reason causing familiarity bias is loss aversion, due to a tendency to avoid loss, choosing familiar stocks might feel safer.

2.2.3.3 Investors' behaviour during COVID-19

As the pandemic continued in 2020, investors started to lose their optimism towards markets. A decrease in optimism was seen worldwide as investors were unwilling to take risks, and a more significant proportion of their investments were moved to lower-risk investments or into cash. (Statista, 2022c; 2022d) While most investors did changes to their portfolios, some reacted in the opposite direction and moved some of their investments into higher-risk investments. Millennials reacted more robustly to the crisis than older and experienced investors, who tend to make no changes in their portfolios even due to uncertain circumstances (Statista, 2022e).

Expectations of the future varied between regions, genders, and investor types. The share of institutional investors, expecting at least a ten percent annual return in the next five years, reduced by 50 percent during 2020 compared to 2019. (Statista, 2022f) At the same time, according to Statista (Statista 2022g; 2022h), individual investors' expectations varied by region, investors in America seemed to be most optimistic, while European investors were least confident about future returns. In the United States, expectations also differed between the genders, male investors were more optimistic, while many female investors expressed their concerns about market developments towards 2021.

In addition to statistics, many researchers have acknowledged the behavioural influence on the stock markets, Basheer (2019, p. 53) concluded that fear and uncertainty shaped

stock markets during the COVID-19, Gormsen and Koijen (2020, pp. 574–575) researched that the actual decrease in share prices was more profound than expected decrease due unexpected elements influencing markets. Ramelli and Wagner (2020, pp. 622–624) noticed that the profits were too high to be controlled by cash flows in substitution of discount rates due to uncertainty. It has also been concluded by Hassan et al. (2020, p. 194) that economies with prior experience of the SARS pandemic outperformed the COVID-19 situation. Prior experience with disasters and pandemics influences the understanding of investors.

Naveed et al. (2021, p. 4) found in their research *Post-Covid-19 investor psychology and individual investment decision: a moderating role of information availibility*, that among Chinese investors, overconfidence, representative bias, and anchoring bias had a significant and positive influence on investment decisions during the post-COVID-19 pandemic. They also found that information availability had an important moderating role in the relationship of psychological biases. One way to assess investors' behaviour, and economic effects is to research share price fluctuation on the line chart, shapes that are formed by these lines are called recession shapes. The following paragraph addresses this topic in more detail.

2.2.3.4 Recession shapes

NBER (2021) describes a recession as a prolonged, significant, and persistent decline or contraction of the economy. It is the period between a peak of economic activity and its subsequent trough or lowest point. Between low and peak, the economy is in an expansion. Although a recession may only endure for a short period of time, it can take years for the economy to rebound and reach its previous levels fully.

A Harvard Business Reviews article (Carlsson-Szlezak, Reeves, & Swartz, 2020) suggests that analysing the shape of an economy's supply output as a time series visualised on a line chart can help assess the impact of COVID-19.

Economics uses these recession shapes to describe different types of recessions and their recoveries. There is no specific academic theory in this field, and shapes are often used as an informal way to describe recession and recovery. Names originate from the shapes of economic data forms during the recession and recovery. Usually used data is gathered information of given economies or company's supply output visualised on a line chart. The most common shapes are V-shape, U-shape, W-shape, and as forthcoming of COVID-19, L-shape that leads to a K-shaped recession. (Challet et al., 2009, p. 12; Dalton et al., 2021, p. 2) These shapes are illustrated in Figure 7.

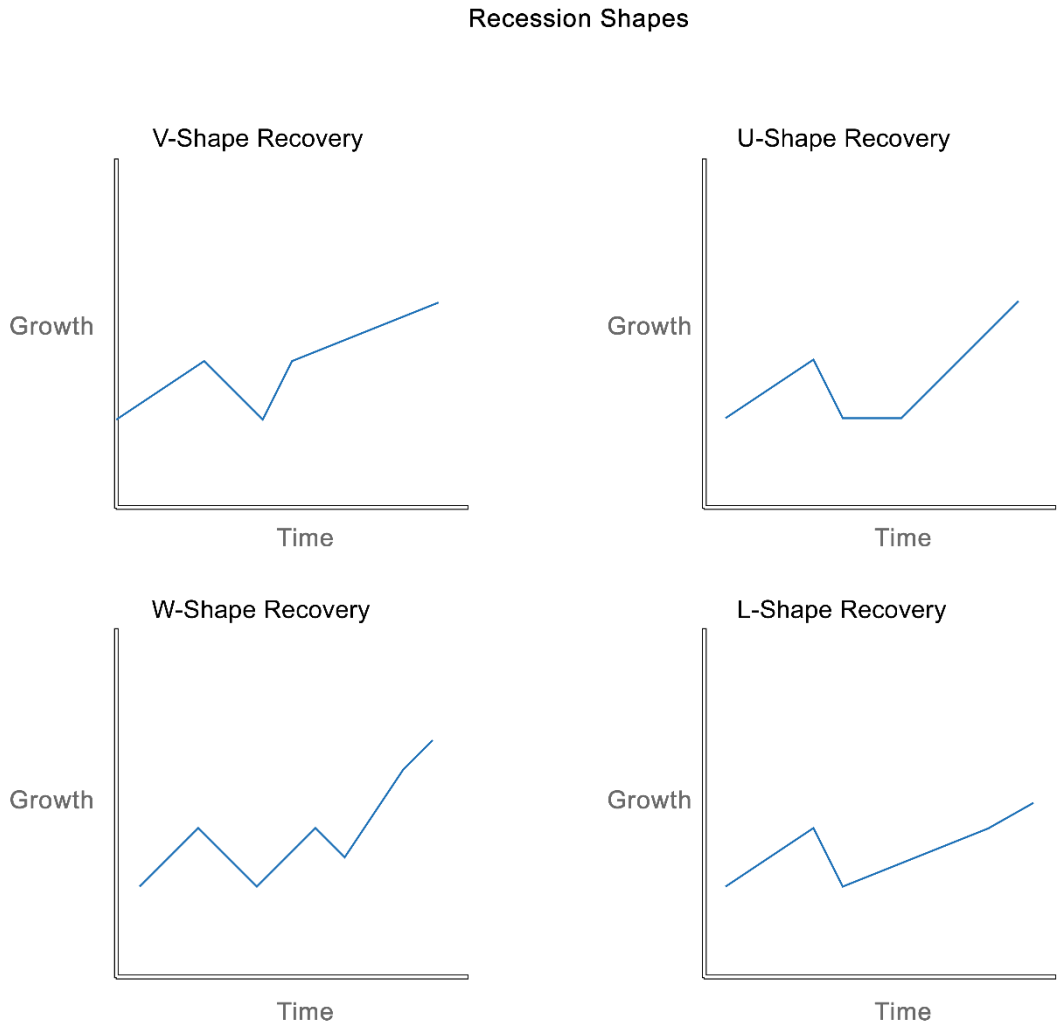

Figure 7. Recession Shapes.

V-shape represents quick recovery after declining. U-shape describes a sharp decline and delayed recovery, which can usually take 12 to 24 months. L-shape indicates severe recession accompanied by high unemployment and stagnant growth. K-shaped recovery implies that different parts of the economy diverge, and some parts of the economy have strong growth while others continue to decline. (Carlsson-Szlezak et al., 2020) Figure 8 illustrates K-shaped formation in the COVID-19 crisis. The hospitality industry is a prime example of an industry that suffered despite the situation improving.

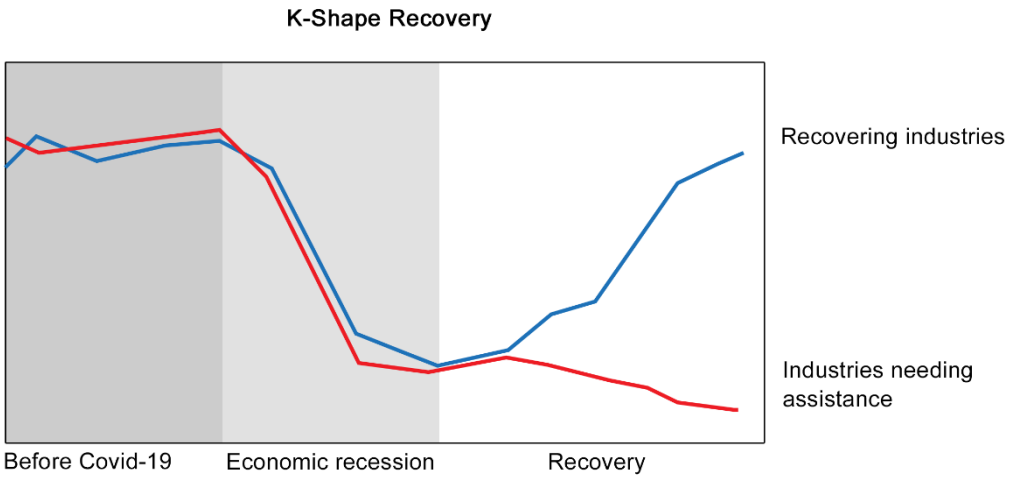

Figure 8. K-Shape Recovery.

The severity of impact varies, but these basic shapes will provide valuable information on which kind of economic effects a shock might cause. Research (Carlsson-Szlezak et al., 2020) argues that the more significant the impact is on supply output, the more it disturbs capital formation, which may affect credit intermediation and even cause a decline in growth in capital stock. In a real economy, this means a loss in productivity, loss of skills, and loss of employees. These effects obstruct the shock recovery, indicating a flattening curve. As prolonged, it can turn structural and cause irreversible damage.

As cited earlier, these recession shapes can be used as an informal way to describe shocks and to estimate short- and long-term effects, but as is, it only poses a simplistic view of the complex phenomenon. One way to broaden this view is by volatility. In recent years, the academic world has become more interested in the volatility impacts of uncertainty shocks (Zhang et al., 2020, p. 172).

2.2.3.5 Volatility during COVID-19

Volatility is one of the main concepts in financial market functions, it indicates the strength of the financial instrument's price fluctuation and measures the uncertainty of stocks value. The higher the volatility value, the more strongly the instrument's price fluctuates from time to time. In this part of the study, research about COVID-19 and volatility are viewed.

One way to evaluate volatility is through the CBOE Volatility (henceforth VIX index), which measures market expectations based on the implied volatility of S&P500 index options. The VIX index is a real-time indication of future volatility. The VIX index rises when price swings are more pronounced, indicating higher volatility. Some publications may also refer VIX index as a fear or panic index. Research (Sauet & Krämer, 2022) of panic in stock markets has shown that declines are frequently brief, indicating that the cause is more rooted in emotion than reason.

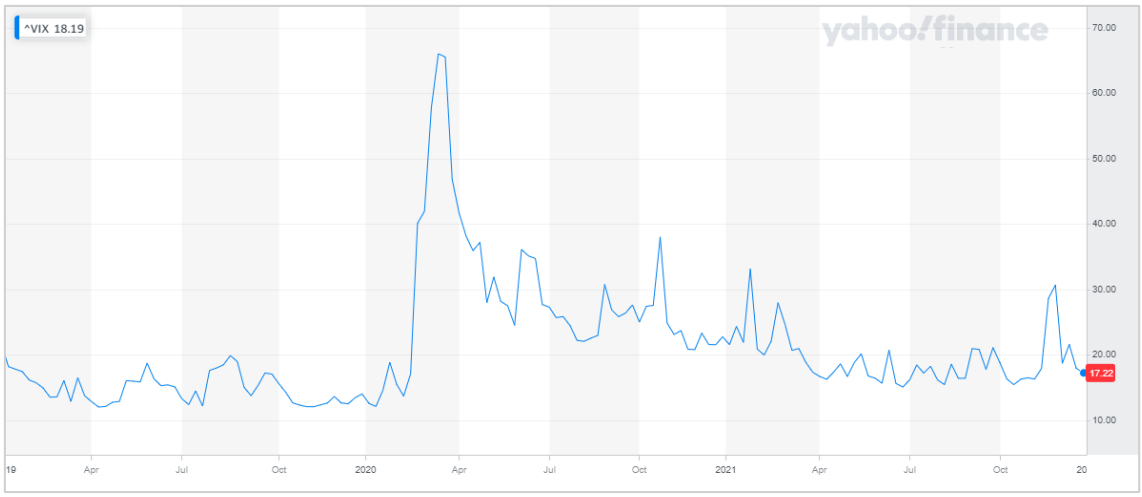

Figure 9. CBOE Volatility Index (^VIX) 1.1.2019–31.12.2021 (Yahoo Finance, 2022).

A detailed examination of the VIX index's behaviour reveals that the COVID-19 crisis significantly impacted the index, as seen in Figure 9. According to Baker (2020, p. 272), the VIX typically ranges from 10 to 30, and any figure over 20 typically indicates market stress. The VIX index reached an all-time high daily close value of 82.69 during the COVID-19 crisis in March 2020, while the Great Financial Crisis saw it reach its second-highest value of 80.86 (Macroption, 2022). This implies that the price variations were particularly erratic during the COVID-19 pandemic and that individuals were anxious about future price adjustments.

Additionally, it implies that investors were significantly more panicked than they were during the Great Financial Crisis. Yet, compared to the past, news are now released more frequently, and social media has emerged as a popular platform for discussions. As a combination this led to an increase in collective panic (McKeever, 2020). As the news often had a sensationalist approach, causing panic not only about financial threats but mainly as a health threat. This heightened public concern may have shifted to the stock market, causing excessive panic, compared to the Great Financial Crisis.

Nevertheless, given that the stock market fall in March coincided with the most significant fluctuations in VIX, fear seems to impact total results negatively. Numerous research

papers from earlier have also proven this type of negative association between volatility and stock returns (Aggarwal et al., 2021, p. 38; Gupta, 2020, p. 1306; Smales, 2016, p. 47). Aggarwal et al. (2021) also discovered that investors become more risk-averse when panic levels rise.

The research (Mazur et al., 2021, pp. 1–8) shows that S&P1500 enterprises experienced extremely high volatility throughout COVID-19. The industry that plunged the most was crude petroleum, which recorded the highest volatility. Additionally, they discovered that stocks that experienced meagre returns during the stock market crash in March 2020 also experienced abnormally high volatility. The theory of rational investors is at odds with this form of asymmetric volatility, where stocks simultaneously have low returns and excessive volatility. For instance, asymmetric volatility may be caused by overreactions or heterogeneous views.

Probability theory presents that sampling correlation should be higher when the movements of random variables are more volatile. This can be seen in the stock markets, along with volatility correlation coefficient raises. (Loretan & English, 2000, p. 29) The next part of this thesis introduces the basics of stock correlation.

2.2.3.6 Stock correlation

In a time of the significant event as COVID-19, when the market is impacted by larger risk, the correlation between stocks increases, and the market risks are continuously transferred throughout the stock markets, creating a contagion effect (Huang & Chen, 2020, p. 54). Stock correlation describes how stock prices move in relation to each other, it is calculated in the form of the correlation coefficient using the standard deviation and covariance, it is presented as a numerical figure between -1 to 1. When there is a perfect positive correlation, meaning that stock prices move in the same direction, either up or down in lockstep, the correlation coefficient is 1. A zero correlation suggests that there is no linear link at all, whereas a perfect negative correlation indicates that two assets

move in opposite directions. Every correlation has additionally a sign and a form. (Jaadi, 2019) Portrayals of positive, non-existing and negative correlations are presented below, in Figure 10.

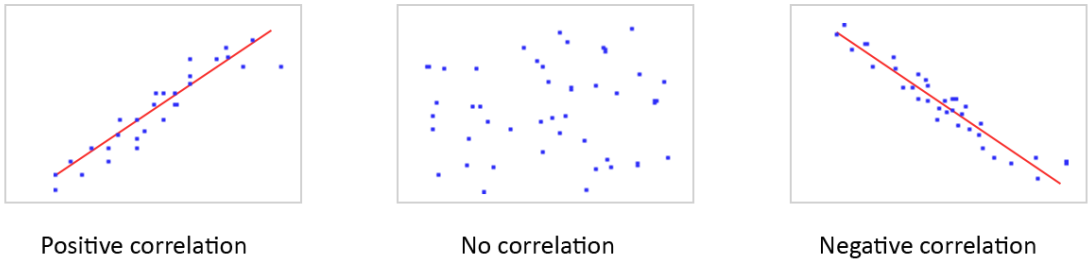

Figure 10. Correlation signs in the scatter plot.

The form of a correlation could be linear, non-linear, or monotonic, as shown in Figure 11. Correlation is linear when the ratio of the proportion of two variables is constant, and the relationship graph is a straight line. When two variables do not change at a constant rate, the correlation is non-linear, forming a curved pattern. Monotonic correlation is defined when two variables aim to move in the same relative direction but not necessarily at a constant rate. (Jaadi, 2019)

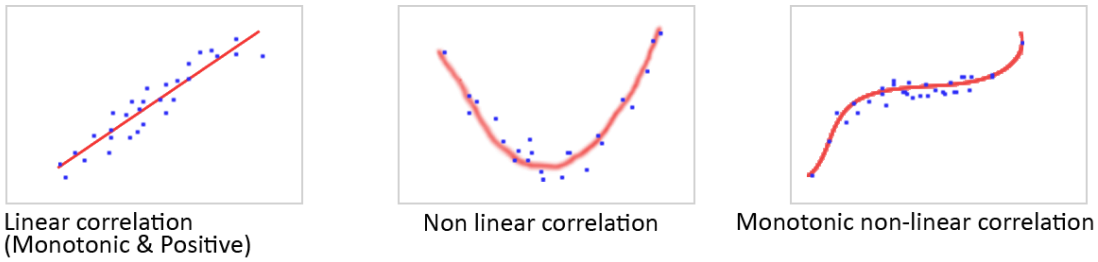

Figure 11. Correlation forms in the scatter plot.

In this thesis, correlations are presented in numerical form and in a scatter plots in correlation matrixes, as researching correlations between Finnish export companies stock prices during COVID-19.

3 Data and methodology

In this chapter, choices for quantitative study are explained and reasoned. First, data collection, limitations and sample are discussed, after that research methodology along with used programs and tests are introduced in way that the research can be replicated.

3.1 Sample, data and limitations

Stock data of selected companies were exported from the Yahoo Finance platform, as well data of OMXH25 index from the observed period, which is 2.1.2019–30.12.2021, counting 755 stock values per share as public holidays and weekends were excluded. This period was chosen due it includes the active phase of COVID-19, and control periods before and after that. From the stock data, adjusted closing prices were separated for analyses, this was chosen over closing price since it is more accurate due it considers distributions as dividends and corporate actions as splits and issuance of new shares. It is also recommended for academic analyses (Jayakumar et al., 2022, p. 385).

Ramelli and Wagner (2020) observed COVID-19's effect on stock markets in the first quarter of 2020 and divided it into three distinct periods of investor behaviour, Incubation, Outbreak and Fever. In this thesis, corresponding time periods were used for the data groups. Since this thesis researches a wider time frame, four new data groups were added based on significant COVID-19 events in Finland. These are the Pre-Pandemic era, Uncertainty, Adaption, and New Normal. Data groups are presented in the timeline in Figure 12.

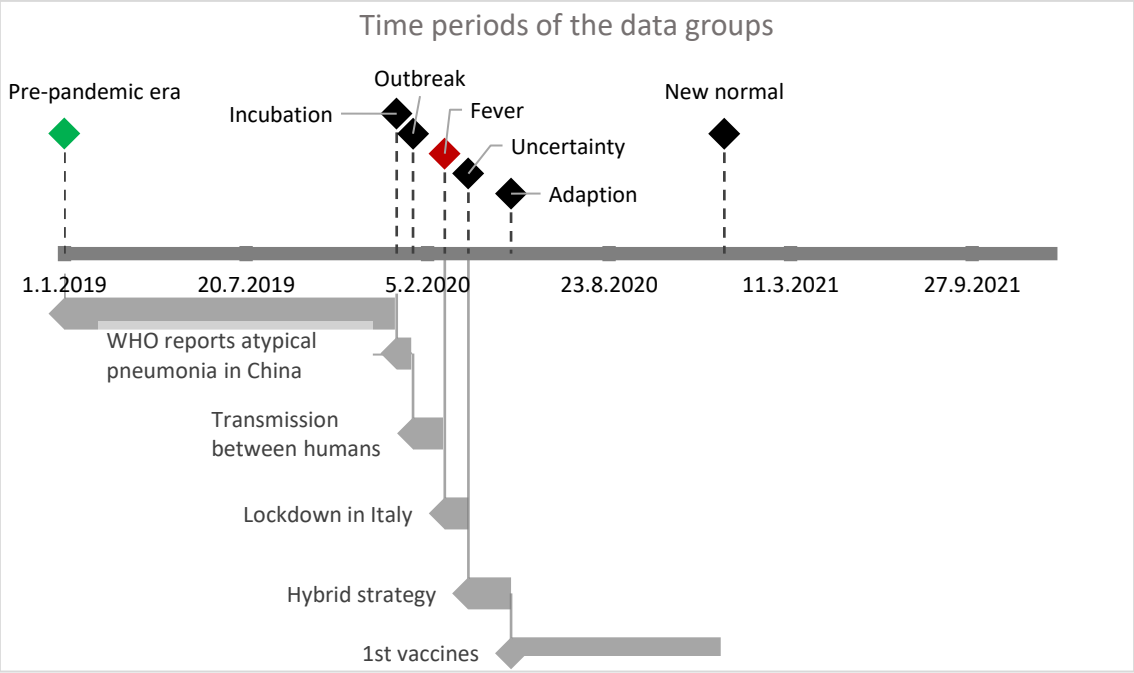

Figure 12. Time periods of the data groups.

The Pre-Pandemic era starts on 1.1.2019 and ends when WHO (2020a) notices a cluster of cases of atypical pneumonia in China. The Incubation period starts after WHO (2020a) reported that in Europe and lasts until Chinese health authorities announced that the virus had been transmitted between humans. This starts the Outbreak period. The Fever period starts after Italian authorities announced the lockdown in the Lombardy region (WHO, 2020a). The Uncertainty period lasts until the Finnish government announces a hybrid strategy to keep the country and economy open (Valtioneuvosto, 2020). This is followed by the Adaption period until the first vaccines arrive in Finland, starting the New Normal period (YLE, 2020c). Precise dates and durations of observation periods are presented in Table 1.

Table 1. Observation periods.

Observation Period	**Start Day**	**End Day**	**Duration (days)**
Pre-Pandemic era	1.1.2019	30.12.2019	364
Incubation	2.1.2020	17.1.2020	16
Outbreak	20.1.2020	21.2.2020	33
Fever	24.2.2020	20.3.2020	26

Observation Period	Start Day	End Day	Duration (days)
Uncertainty	21.3.2020	6.5.2020	47
Adaption	7.5.2020	23.12.2020	231
New Normal	28.12.2020	30.12.2021	368

The most significant export companies listed on the Helsinki Stock Exchange were selected for this study. Significance was defined based on the export volume, the extent of the export market and the company's value.

Most of the selected companies have been listed in the Forbes 2000 list for several years (Kaggle, 2021) and have significantly influenced Finland's GDP. Forbess 2000 list ranks the largest companies in the world using four metrics: sales, profits, assets, and market value (Murphy & Contreras, 2022). In addition, a few large and well-known companies were selected to bring diversity to the export products. Companies that are focused on service exports were excluded from the study.

The companies selected for the study are presented in Table 2, which also offers more detailed information about each.

Table 2. Companies selected for the study. (Orbis database, 2022)

COMPANY	Traded on	HQ	Revenue (2019)	Products
Fiskars	Nasdaq Helsinki: FSKRS	Helsinki, Finland	€1.21 billion	Scissors, gardening tools, kitchenware, glassware, ceramics, knives, outdoor equipment
KONE	Nasdaq Helsinki: KNEBV	Helsinki, Finland	€10.5 billion	Elevators, escalators, automatic building doors
Metso/Metso Outotec	Nasdaq Helsinki: MOCORP	Helsinki, Finland	€3.6 billion	Industrial company serving the mining, construction, recycling, oil and gas, pulp, paper, and process industries.
Neste	Nasdaq Helsinki: NESTE	Espoo, Finland	€15.84 billion	Refined oil products, renewable fuels
Nokia	Nasdaq Helsinki: NOKIA NYSE: NOK (ADR)	Espoo, Finland	€23.34 billion	Communications equipment

COMPANY	Traded on	HQ	Revenue (2019)	Products
Nokian Tyres	Nasdaq Helsinki: TYRES	Nokia, Finland	€1.6 billion	Tyres
Outokumpu	Nasdaq Helsinki: OUT1V	Helsinki, Finland	€6.4 billion	Stainless steel
Stora Enso	Nasdaq Helsinki: STEAV, STERV Nasdaq Stockholm: STEA, STER	Helsinki, Finland	€10.06 billion	Packaging materials, biomaterials, wooden construction, and paper
UPM-Kymmene	Nasdaq Helsinki: UPM	Helsinki, Finland	€10.24 billion	Pulp, paper, plywood, sawn timber, labels and composites, bioenergy, biofuels for transport and biochemicals
Wärtsilä	Nasdaq Helsinki: WRT1V	Helsinki, Finland	€5.2 billion	Power plants, marine propulsion systems, maintenance services

3.2 Data analysis

To be more precise, this thesis examines changes in stock values of several companies during the same time period, from the beginning of 2019 to the end of the year 2021, in order to answer the research question, *What is the impact of COVID-19 the on stock market performance of Finnish export companies?* By analysing stock values in different ways, research answers to the first sub-question, *How did this crisis affect the stock prices of Finland's ten biggest export companies?* Secondary research and statistical data are used to answer the second sub-question*, Can the effects be explained by behavioural finance?* The final query is to assess the quantitative study by applying it to the theory of the literature part of this thesis.

To analyse data and to form graphs, R was used, it is a language and environment for statistical computing and graphics. The language is widely used for data analysis in academia and large companies.

In the first phase, data were exported from Yahoo Finance (2022) and imported into R. Then the data was processed, redundant data were pruned, and adjusted closing prices were prepared for use. After, data was transformed into a line chart and reviewed through recession shape theories, focusing on the overall situation and the visible effects of the COVID-19 shock.

In the second phase, data were divided into the previously mentioned data groups, which, after a correlation matrix was created on each group, to see if there was causality between companies. The significance of the correlation is evaluated by a t-test. As previously mentioned, correlations are presented numerically and in a scatter plot in correlation matrixes. Numerical values are calculated using Pearson's correlation (r), which measures the strength and direction of the relationship between two variables. It was chosen due it is dominantly used in academic research as a standard when researching correlations between stock price movements, this enables comparability of the results. (Guo, et al. 2018) Other options would be non-parametric Kendall and Spearman correlation tests.

Pearson correlation coefficient is calculated by using formula,

$$r = (\sum\ (x_i - \overline{x})(y_i - \overline{y}))/(\sqrt{\sum\ (x_i - \overline{x})^2 \sum\ (y_i - \overline{y})^2}),$$

Where, r = correlation coefficient, x_i = values of the x-variable in a sample, $\bar{x}$ = mean of x variable, y_i = values of the y-variable in a sample, and $\bar{y}$ = mean of y variable.

The following Table 3 was used to interpret the strength of a correlation coefficient,

Table 3. Values of correlations and interpretations.

Value of Correlation	**Interpretation**
.90 to 1.00 / -.90 to - 1.00	Very high positive correlation / negative
.70 to .90 / -.70 to -.90	High positive correlation /negative

.50 to .70 / -.50 to -.70	Moderate positive correlation / negative
.30 to .50 / -.30 to -.50	Low positive correlation / negative
.00 to .30 / .00 to -.30	Negligible correlation

Next t-test was performed, to evaluate significance of correlations. For that t-score was calculated, it is corresponding to the number of standard deviations away from the mean of the t-distribution (Scibbr, n.d.). T-score is calculated by using formula,

$$t = r\sqrt{(n-2)/(1-r^2)},$$

where, r = correlation coefficient, and n = sample size.

After that corresponding p-value was solved by using the T score to P value calculator, as a statistical measurement, the p-value, or probability value, is applied to validate a hypothesis against observed data. It assesses the probability of obtaining the observed results if the null hypothesis is true. The statistical significance of the observed difference is greater - the smaller the p-value is. Significance levels that evaluate p-value are, ***:0-0.001; **:0.001-0.01; *: 0.01 - 0.05. For example, p value > .0.05 indicates that less than 5% supports null hypothesis, and with a probability of >95%, the null hypothesis can be rejected. Hypothesis in this research were, H0: There is no significant correlation between the factors, and H1: There is a significant correlation between the factors.

In the third phase companies' volatility was calculated and transformed as histograms to evaluate trends. In this thesis, historical volatility was used, it is a measure of past performance, and calculated using standard deviation, the square root of the variance. Formula of historical volatility is,

$$\sigma = \sqrt{T}\sqrt{(\sum_{i=1}^{n}(R_i - \bar{R})^2)/(n-1)},$$

where, T = number of trading days, n = historical volatility period, R_i = logarithmic returns, and $\bar{R}$ = standard deviation.

In the final phase, the most important news related to COVID-19 was gathered and superimposed on the line chart created in the first phase, intending to detect if the news affected the stocks.

3.3 Reliability

Reliability is defined as a quality standard that determines the credibility of this thesis's results. It refers to the stability and consistency of findings when research is repeated using the same methods. (Creswell & Poth, 2013) To ensure this, the methods used in this thesis are based on established theories, formulas and concepts widely used in academic research. Only primary data from well-established and public sources were used to ensure the credibility of the data. To avoid observer bias, all data, periods, companies, and selected news were chosen before conducting any research.

Possible interpretation errors are related to the behavioural part of the thesis, as investors' behaviour is not directly measurable, and even a survey would only offer partially reliable results due to the nature of investor biases. However, general theories and previous studies were used to interpret the results.

In the correlation research, time periods may affect the results, to minimise it, this thesis used corresponding periods widely used in COVID-19 related studies, equally long control periods, and a visual chart of the stocks was used to support the interpretation of the results. As the companies researched are publicly listed companies, investors outside of Finland had to be considered. Therefore, globally significant events and news alongside the VIX index were added to the research.

4 Empirical results

In this chapter, results are presented in four sections. The first section covers the overall effect of COVID-19, the second presents correlation results, the third analyses results of calculated volatility and the last investor behaviour is researched and discussed.

4.1 Overall effect

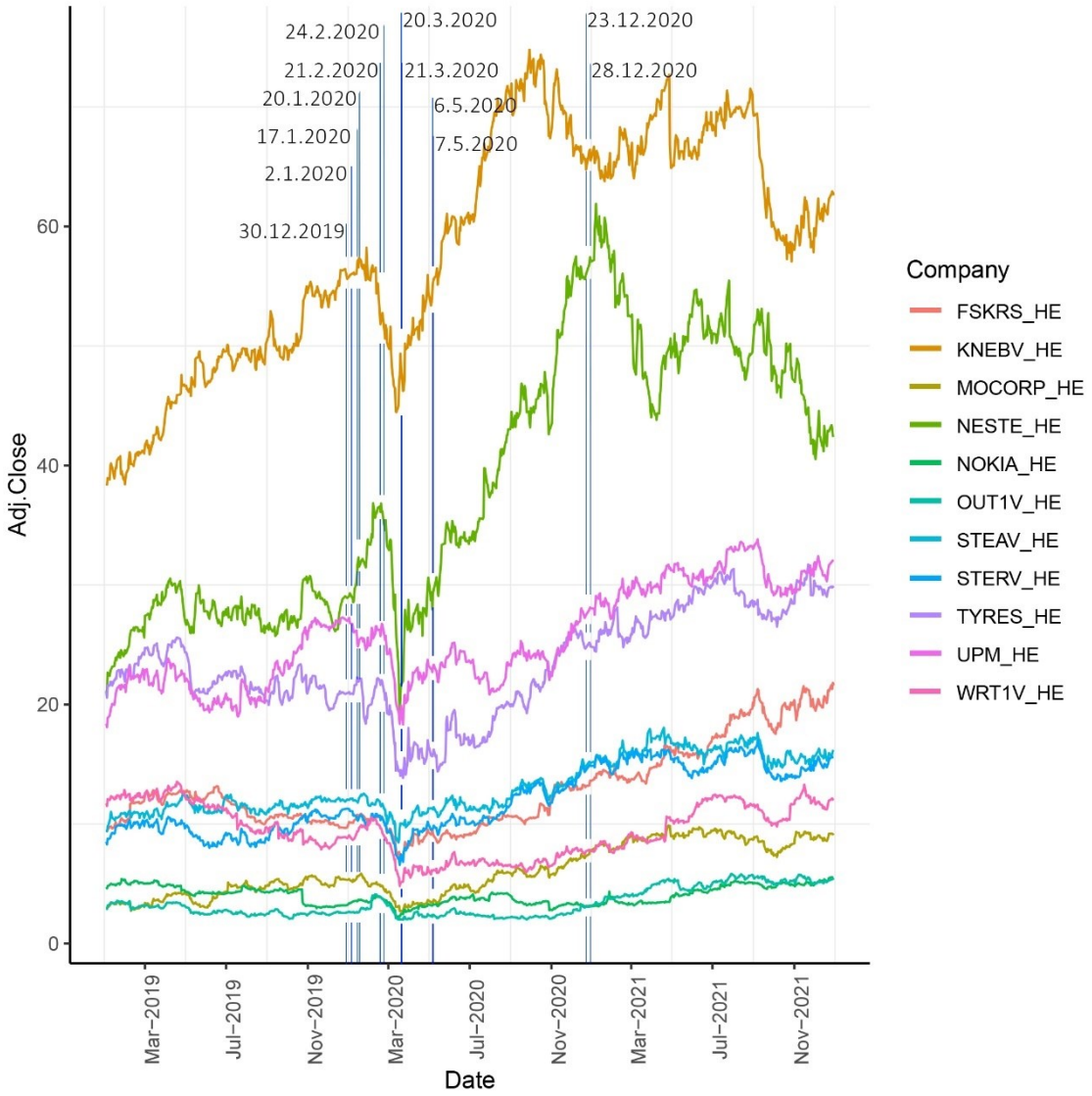

Figure 13. Stock prices in the line chart.

Prior to delving into the stock data and correlations, it is important to consider the overall trajectory of the pandemic from an investor's perspective. The preceding chart, Figure 13, contains all companies' stock prices during the whole time period, Y-axis describes an adjusted closing price of the stocks, and X-axis is the timeline. Vertical lines imply the time periods.

Upon initial observation, it is evident that a V-shaped shock occurred towards the end of February 2020. The lowest point was noted in mid-March, with an average drop in value of around 30%. All companies experienced a decline in their share prices, reaching their lowest point during this observed time period. Henceforth this major V-shaped phenomenon is referred as a free fall/March free fall. This after the stocks started to rise, but not as sharply, citing uncertainty. According to Carlsson-Szlezak et al. (2020), a V-shaped recovery suggests that COVID-19 impacted companies, but the supply loss was manageable. However, the loss of production during the spring was permanent.

For analysis, companies are divided into four price groups standing out from the chart. From the bottom of the chart, it can be observed that Metso Outotec has a strong revert, but they had a significant merger in July 2020, which affected the company's overall value. The stock values decline of Nokia was not significant, and it stabilised quickly. Digital Transformation Sales Lead Mohamed (2020) from Nokia stated that "The ICT sector is one of the least impacted sectors during COVID-19, and it was expected to recover faster post the pandemic as the world is in need to be more connected and many businesses were rethinking of accelerating their digital transformation strategies." According to Nokia's interim report (2020), most of their R&D employees worked from home, met the objectives, and even proceeded ahead of schedule. Additionally, there was a massive increase in network capacity demand, which positively affected the company. (Nokia, 2020)

Outokumpu had a W-shaped shock, and it took seven months to start recovering from the shock. This shape indicates extreme volatility and affects investors' trust due after

they assume the stock has found a bottom, it falls again. As differentiating from other stocks that kept rising after the shock, this “double dip” might have affected to slower recovery. According to the interim statement of Outokumpu (2020), demand slowed down also due to increased and aggressive competition among export companies looking for open markets, as the steel demand was reduced, and many countries were under lockdowns. Among the general uncertainty also the steel markets suffered uncertainty. As for the future, Outokumpu developed a range of scenarios with specific action plans, reducing the effect of similar shocks.

Of the second group, Wärtsilä had a similar reversion to Outokumpu and declined nearly 50% of its stock value. Wärtsilä's order intake fell by more than a quarter between April and June, and the profit was less than half of the corresponding time of the previous year. According to the CEO, Jaakko Eskola, a noticeable effect was on their maintenance business. Customers also postponed their orders due to uncertainty. (Mäntylä, 2020) In response to COVID-19, Wärtsilä (2020) took proactive steps to minimise the global impact on their operations, preparing to capture future opportunities as markets fully recovered. By implementing proactive risk-mitigating actions, including buffer stocks, and identifying alternative operating models, the company aimed to avoid further disruptions.

Fiskars’ course was bullish and achieved a distinctly higher price at the end of the review period compared to the Pre-Pandemic era. Fiskars (2020) similarly took proactive actions, such as reducing office personnel work hours and laying offing store- and factory personnel, to mitigate the negative impact of COVID-19. CEO of Fiskars characterised risks as enormous in such uncertain times, and the company focused on improving profitability through primary restructuring and change actions. As can be seen from the chart, Fiskars fears did not take place, and the company succeeded in mitigating the problems seen in global supply chains, which gave them a competitive advantage. (Fiskars, 2021) The company has large factories in Thailand and Indonesia and a smaller factory in China.

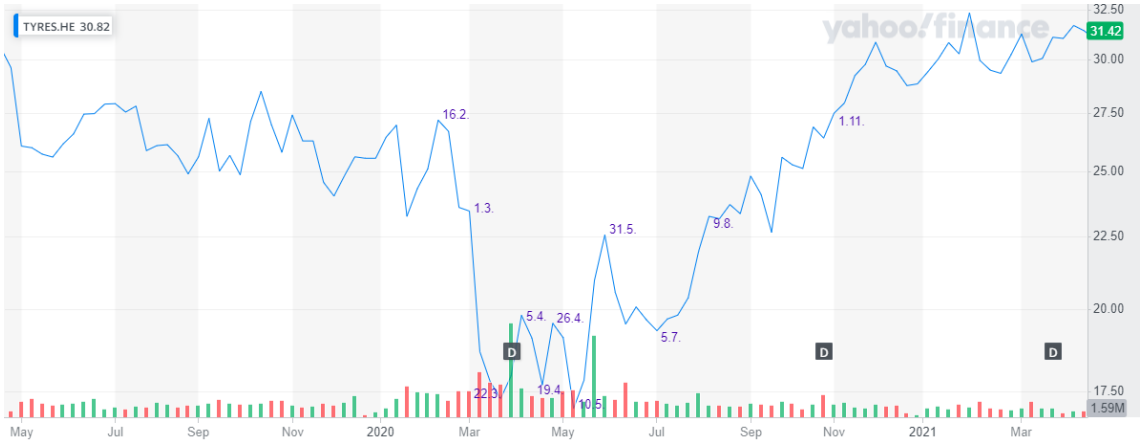

Figure 14. Nokian Tyres W-shaped decline (Yahoo Finance, 2023).

In the third group, Nokian Tyres faced a similar W-shaped shock as Outokumpu and Wärtsilä. Solely Nokian Tyres were selected for this review hence it demonstrates a clear view of W-shaped shock, and as presenting that by its own, the stock chart will not scale too far to interpret due to differences in the stock values. The close-up of the stock movements is presented in Figure 14.

X-axis indicates the day, and the Y-axis the price. The blue line presents price movements, the green and red bars at the bottom of the chart represent volumes, the green bars indicate that the stock closed higher as on a previous interval, and the red bars indicate a lower closing price compared to a previous interval. The length of the bar characterises the relative trading volume on that interval compared to other intervals. In this chart, one interval is one week.

The sharp decline started at 1.3. and continued three weeks to 22.3. decline in the stock value was -26%, by 5.4. the stock increased 14%, which after it declined again and so forth. Strong growth started at 10.5. and it continued to 31.5. The stock reverted to the same level before the first decline on 9.8., counting 161 days or five months and eight days intense period for investors. In the interim report Nokian Tyres (2020) announced that they had enough buffers to succour with the delays of raw materials, they also already had alternative suppliers in case primary suppliers would have delivery difficulties.

As a precautionary measure company temporarily stopped production at its factories to protect the health and safety of the employees. The company also applied measures to strengthen its liquidity position and announced that its strong balance sheet will help over the uncertain period (Nokian Tyres, 2020).

Neste experienced a V-shaped shock but recovered in four months, which after the stock kept rising, exceeding expectations. CEO Peter Vanacker of Neste stated (2020) that COVID-19 did not affect the company's deliveries or services, and despite the situation, the company's strategy did not change. Although he predicted unprecedented volatility in the fuel market, as which consequence, they anticipated a challenging market environment in the oil products business.

As in the own, fourth price group is Kone, it also faced a steep V-shaped shock, recovering in four months and rising after that as Neste. CEO Henrik Ehnrooth said that the company managed to increase turnover in the middle of the corona crisis, they expected the Chinese market to recover but were surprised at how fast it happened, and it was unexpected how strongly it grew (Mäntylä, 2020).

Small clusters of V-shapes can be detected at the end of October 2020, at the end of February 2021, and at the end of November 2021. However, stock values rebounded faster after each minor shock, indicating that the real effects remained small. In the fall of 2021, the stock market experienced a decline, which may be attributed to the flu season. Additionally, there was increased media coverage of COVID-19 during this time. Stora Enso, UPM, and Nokian Tyres had a slow recovery, resulting in a slight U-shaped decline. Nevertheless, as valuations of these companies had already proceeded Pre-Pandemic era, stocks presumably sought a real valuation. In the final phase of this research, we will lay out COVID-19 related news over the chart to see if there is a relations.

Table 4. Companies stock price development. (Yahoo Stocks, 2022)

Company	Lowest, €	Highest, €	% change	Date of lowest
Fiskars	8,14	23	183	15.3.2020
KONE	45,10	75,44	67	8.3.2020
Metso/Metso Outotec	2,89	10,15	251	15.3.2020
Neste	23,21	62,66	170	15.3.2020
Nokia	2,32	5,57	140	8.3.2020
Nokian Tyres	17,01	35,56	109	22.3.2020
Outokumpu	2,1	6,01	186	29.3.2020
Stora Enso A	9,94	18,25	84	8.3.2020
Stora Enso R	8,04	17	111	15.3.2020
UPM-Kymmene	22,88	35,05	53	8.3.2020
Wärtsilä	5,59	12,94	131	15.3.2020
OMXH25 index	3040,69	5749,88	89	15.3.2020

As Table 4 indicates, each company had a significant increase in their stock prices by the end of 2021. The lowest closing prices were positioned collectively along the first COVID-19 shock, on the bottom of the March free fall. The highest closing prices were reached after it at various times. These highest closing prices were higher than the highest prices before COVID-19, indicating excellent performance despite the crisis. It also presents the possibilities that short-term investors had to make a profit.

4.2 Correlation

In this chapter, the results of the Pearson correlation coefficient are presented. To preserve readability, only a few figures of the correlation matrixes are presented, the rest are in appendices. As there are 52 possible combinations of correlations between companies in one period, totalling 364 correlation pairs, as there are seven time periods, not all of them are analysed. Instead of standing out correlations, odd changes in correlations and overall periods are compared and analysed. Precise instructions are presented next to make it possible for readers to explore and analyse all correlations.

The analysis uses numerical values, which measure the strength of the relationship between two variables, values are placed between -1 and 1. A value of positive 1 indicates

perfect correlation, alias, one variable decrease 10%, so does the other, and a negative value indicates that as one share price increases, the other decreases. Zero (0) indicates that there is no correlation at all, a change in other does not cause a change in the other. (STHDA, 2022)

As looking at Figure 14, the correlation matrix; the Values of the correlations are in the upper right triangle, significance is marked by red asterisk. In example:

(1) Correlation between Fiskars and Wärtsilä is .66 (top right corner), the correlation between Fiskars and Nokian tyres is .62 (first row from top, third last), and the correlation between Fiskars and Kone is -.31 (first row, first number).

So, the correlation between companies is the number in the point of the cross-section of companies. Stock abbreviations are in centres across the top left to the downright. Each variable's distribution is also on the diagonal, and kernel density is overlaid.

On the lower left triangle are scatter plots with a fitted line. Numbers on the X and Y-axis present companies' stock values in euros through the time period of a correlation matrix. As example:

(2) In Figure 14, Fiskars price has fluctuated around 10-12 euros, Kone's (KNEEN_HE) around 40-50 euros.

In addition, companies' names and corresponding stock abbreviations can be found in Table 1. in this thesis. Values of correlations and interpretations were introduced in Table 3 but have also been added below for clarity.

Value of Correlation	**Interpretation**
.90 to 1.00 / -.90 to - 1.00	Very high positive correlation / negative
.70 to .90 / -.70 to -.90	High positive correlation /negative

Value of Correlation	Interpretation
.50 to .70 / -.50 to -.70	Moderate positive correlation / negative
.30 to .50 / -.30 to -.50	Low positive correlation / negative
.00 to .30 / .00 to -.30	Negligible correlation

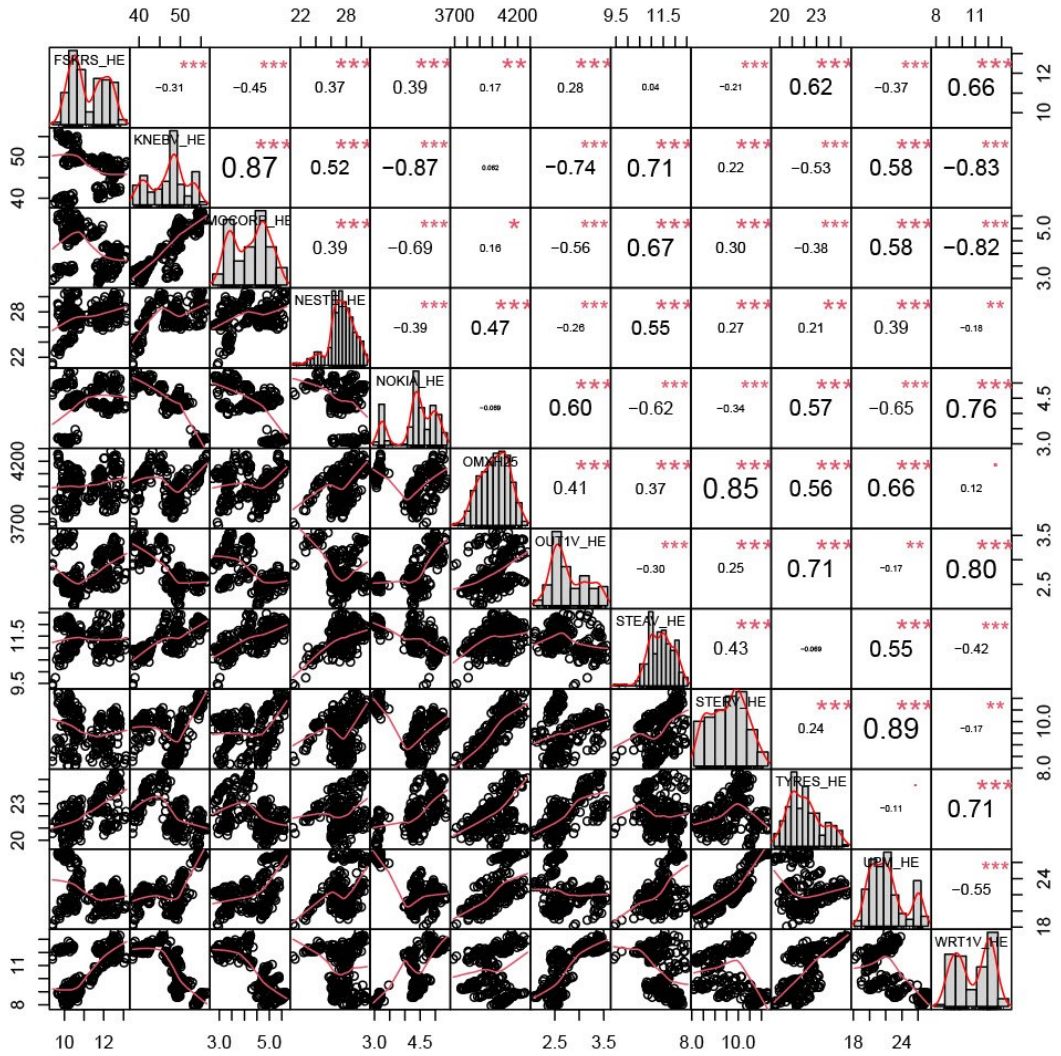

Figure 15 Pre-Pandemic correlation matrix.

The Pre-Pandemic era, figure 15, was 1.1.–30.12.2019, lasting 364 days. In the Pre-Pandemic era, there was only four high positive correlation between companies operating in similar fields, UPM and Stora Enso, Wärtsilä and Outokumpu. Otherwise, correlations are scattered without any significance, negligible and negative correlations were

common. The highest correlation is between Stora Enso and UPM, .89 and the lowest is between Kone and Nokia -.87. Correlations with the OMXH25 index are minor.

The Incubation period was 2.1.–17.1.2020, lasting 15 days. During this period amount of positive correlation was significantly higher compared to the Pre-Pandemic era. However, it should be noted that the time period is drastically shorter, making correlations more likely since there are fewer variables. Outokumpu, Stora Enso and UPM stand out from the rest by having negative correlations with others. However, it is notable that UPM and Stora Enso had a very high positive correlation, .96 among them. The highest correlation is .97 between Fiskars and Nokian Tyres.

The Outbreak period was 20.1.–21.2.2020, lasting 33 days. Correlations are scattered compared previous period, there are no clear patterns. Wärtsilä was diverging from other stocks by having at most low positive correlations. Nokia was the first time to have a very high positive correlation with the OMXH25 index. Overall correlations are either moderate to high positive or negligible to negative. The highest correlation is between Outokumpu and OMXH25 index, with a very high positive .96. The lowest is between Stora Enso and Kone, -.088.

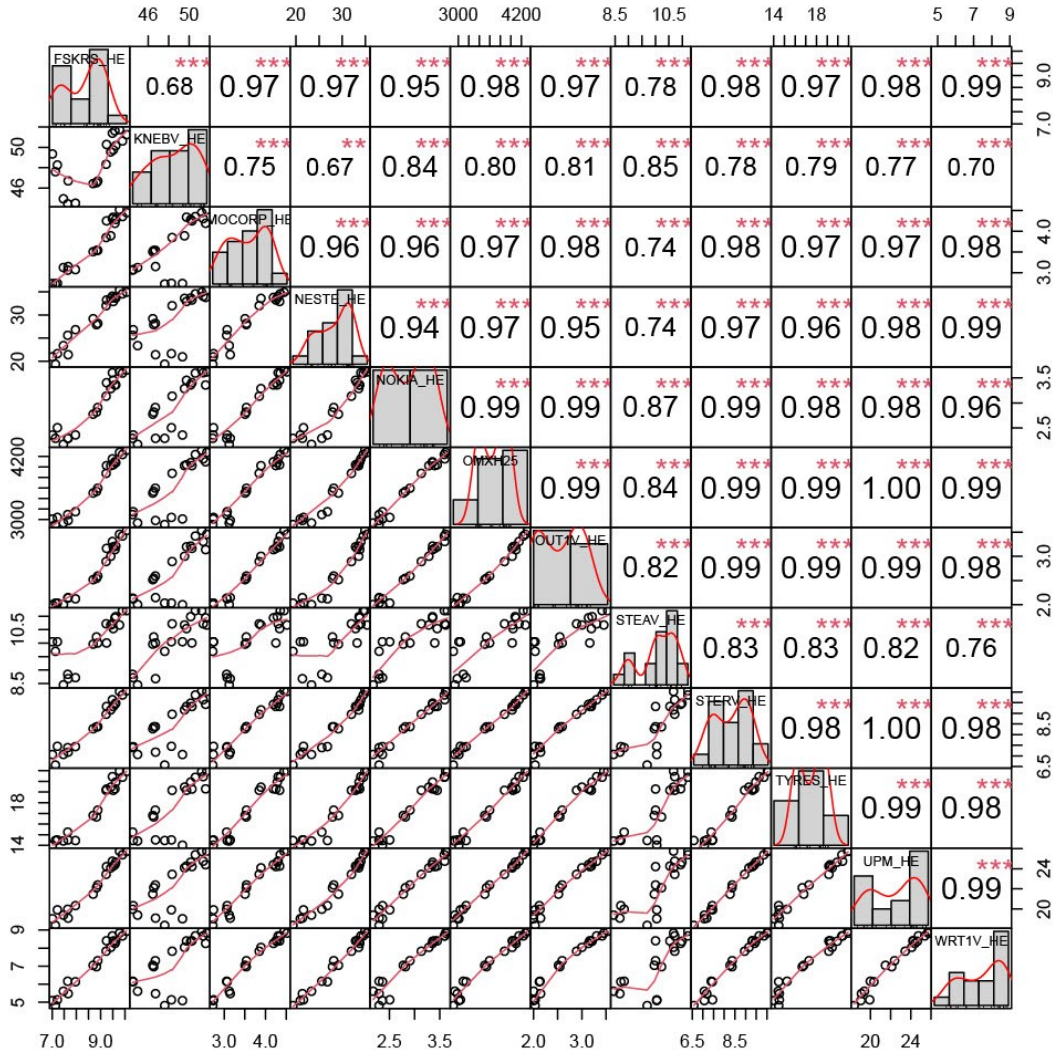

Figure 16. Fever correlation matrix.

The Fever period, figure 16, was 24.2.–20.3.2020, lasting 26 days. During the fever period, all stocks had a very high positive correlation, indicating a partially apparent phenomenon, financial instruments tend to correlate during the decline period. However, during the COVID-19 correlation phase lasted long and was particularly strong, including the March free fall of stocks which can be observed here. That could be explained by the strength of negative emotions over positive ones, an investor's reaction to a crisis is more profound than excitement in growth periods. As panic sets in, feeding herd behaviour, investors start to sell, leading to the collapse of the quotations as more and more

investors rush to liquidate holdings. As a balancing power are speculators that even out supply and demand by buying at low prices. The COVID-19 situation was so indistinct that panic exceeded speculators, and the decline lasted longer and was more intense. However, it is interesting how these stocks moved in tandem; the decline was almost the same. UPM and Stora Enso, as well as UPM and OMXH25 index, moved exactly in tandem, having a correlation of 1.00. Investors were left uncertain by the prolonged decline in tandem, which lacked any clear financial explanation. This made it difficult to analyse or form future expectations based on traditional finance theories, leaving news and virus-related announcements as the sole sources of information.

The Uncertainty period was 21.3.–6.5.2020, lasting 47 days. Compared to the Fever period, this can be seen as a growth period, awareness had increased, and the support packages promised by the government accelerated trade. However, correlations are not as high as in the Fever period, which could be since, as an emotion, positivity is less herding and contagious as negativity, panic spreads faster than hope. Overall, correlations were still strong. Wärtsilä and Nokian Tyres had seemingly lower correlations but still moderate positives. By looking at the previously presented chart, it can be observed that these companies experienced a W-shaped recovery as opposed to a V-shaped recovery like most others. This indicates that these stocks faced greater declines and therefore had a slower recovery process.

The Adaption period was 7.5.–23.12.2020, lasting 231 days. The correlation matrix indicates that stocks were starting to separate. However, the period is significantly wider. Then again, high positive correlations represent a much larger part as in the Pre-Pandemic period implying the high correlative effect of COVID-19 lasted at least until the end of 2020. Upon comparing this matrix to the overall effect chart, it becomes apparent that growth and smaller declines during the same periods are the primary factor of correlation. Stocks reacted in unison to the news or events that caused a momentary decline, generally high positive and very high positive correlations representing most correlations. Nokia is an exception by having only negative correlations, pointing out the

almost non-existent real effect of COVID-19 on their operations. That is an interesting deviation as Nokia correlated among others during the previous periods, but it clearly follows its real value without excess growth or declines in this period. Outokumpu also had exceptionally low correlations.

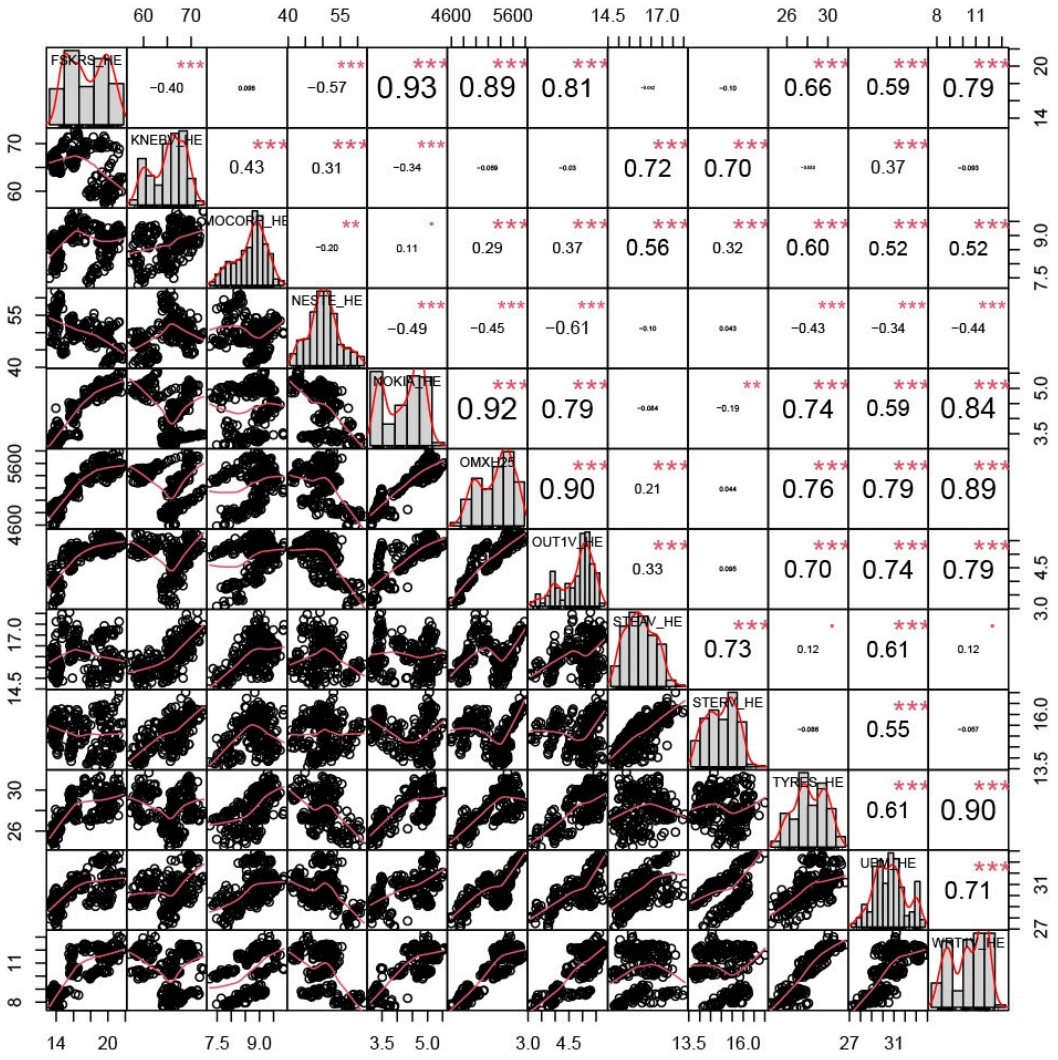

Figure 17. New Normal correlation matrix.

The New Normal period, figure 17, was 28.12.2020–30.12.2021, lasting 368 days. The situation resembled the Pre-Pandemic era, but there were more moderate, high, and even very high positive correlations between companies that correlated just a minorly

before. As a noteworthy change, Fiskars and Nokia have a high and very high positive correlation with the OMXH25 index, as before the pandemic, the correlation was negative and negligible, and in the previous period Nokia was following its own path.

In conclusion, these correlation matrixes demonstrate well the course of the crisis, and the results indicates similar results as the previous studies (Wu, et al. 2022 ; Das, et al. 2019 ; Liu, E. 2019), the stock market tends to start correlating during a crisis, especially when volatility is high. Although this research points out that correlations do not only correlate during the crisis, but correlations can also be visible even after a one year.

Correlations between companies and OMXH25 index were sporadic before the Outbreak period, when the amount of high correlations began to increase. As with every company, also OMXH25 index had exceptional correlation in the Fever period. Notable is that high correlations continued through the Uncertainty and Adaption periods. After the Fever period, OMXH25 index gradually increased at a near-linear 45-degree angle until reaching the end of the research period.

The COVID-19 crisis was exceptional because financial consequences and effects were unknown when the stock market plummeted in the Fever period almost in perfect tandem. A company's size, products, export markets or any other variable did not matter in this decline. The contagion effect went through the stock market, accelerating risk spillover.

Due to that Incubation period had notably more correlations than the Outbreak period, which preceded the Fever period, indicates that COVID-19's united correlative effect started during the Fever period, on week eight. But it is probable that the Fever period in Finland started earlier than the week eight. As verifying validity of these correlation tests results by comparing these with the overall chart and daily spesific data from raw data, smaller pre-decline clusters can be identified starting on week six. Kone, Nokia and Wärtsilä started declining already on Monday 3rd of February. Nokian Tyres, Outokumpu,

Storaenso and OMXH25 index on Monday 10th of February. Fiskars, Neste and UPM on Monday 17th of February. The Fever period and major decline of all started on Monday 24th of February. This matter is examined in more detail in the chapter 4.4.

Notwithstanding, strong correlations from the Fever period continued through the Uncertainty period, as an exception were Wärtsilä, Nokian Tyres and Outokumpu. These companies had higher volatility and suffered a W-shaped decline, slowing recovery.

In the adaption period, Nokia stood out by having only negative correlations, regardless of other companies where the post-shock correlation was still visible. During the same period, Nokia had stated that COVID-19 would not affect their business. Hence it appears that investors noted this.

In the New Normal period, the most notable common factor was the decline in September–October 2021. Correlations were also raised during other flu seasons after uneventful summers. This study notes that regular flu season during COVID-19 directed most attention to COVID-19. As the virus gained more space in media, correlations rose. Though, over time correlations got smaller, uncertainty was dissipated, and awareness increased so that real financial effects could be assessed. Uncertainty and awareness steered correlations, highlighting behavioural aspects.

As correlation and volatility are often connected (Davis et al., 2020), it is also natural to research volatility. The next part of the study discusses the results of that research.

4.3 Volatility

Davis et al. (2020) illustrated that the market volatility associated with COVID-19 was exceptional. As mentioned in the literature review, market volatility is often connected with investor behaviour, especially with herding. Therefore, these companies' volatility during the period was analysed.

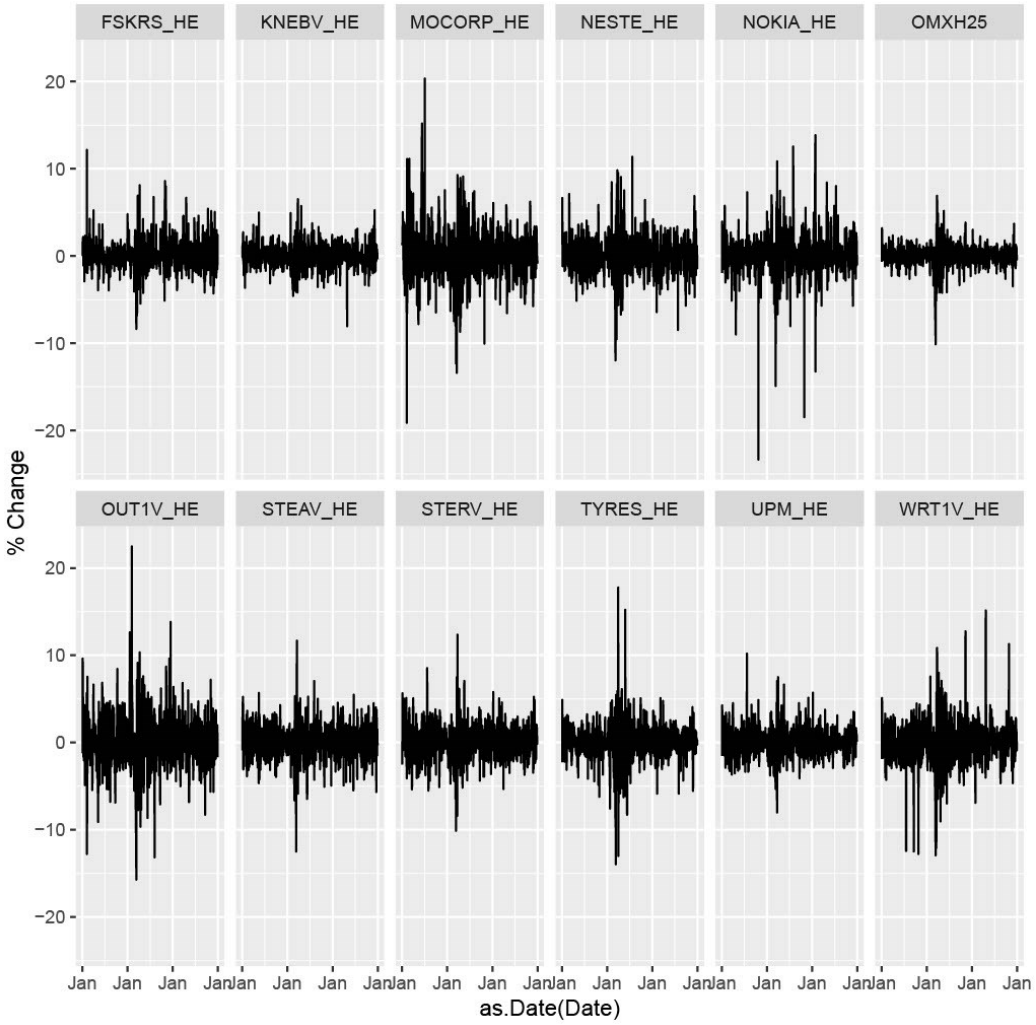

Figure 18. Volatility histogram.

The plot histogram in Figure 18 illustrates researched stocks and OMXH25 index volatility during the whole observation period, more detailed plots can be found at the end of this thesis. The X-axis implies yearly time, January to January, and the Y-axis percentage change. As simplified, the more dispersed the black area is, the higher its volatility.

Overall volatility among companies was elevated all the time compared to the OMXH25 index, which was also unprecedented. As a trend, we can detect volatile eruptions at the end of February 2020, continuing through March, this aligns with the findings of Ramelli and Wagner (2020) about the Fever-periods high volatility. Although these findings point out that the volatility proceeded longer than Ramelli and Wagner had researched.

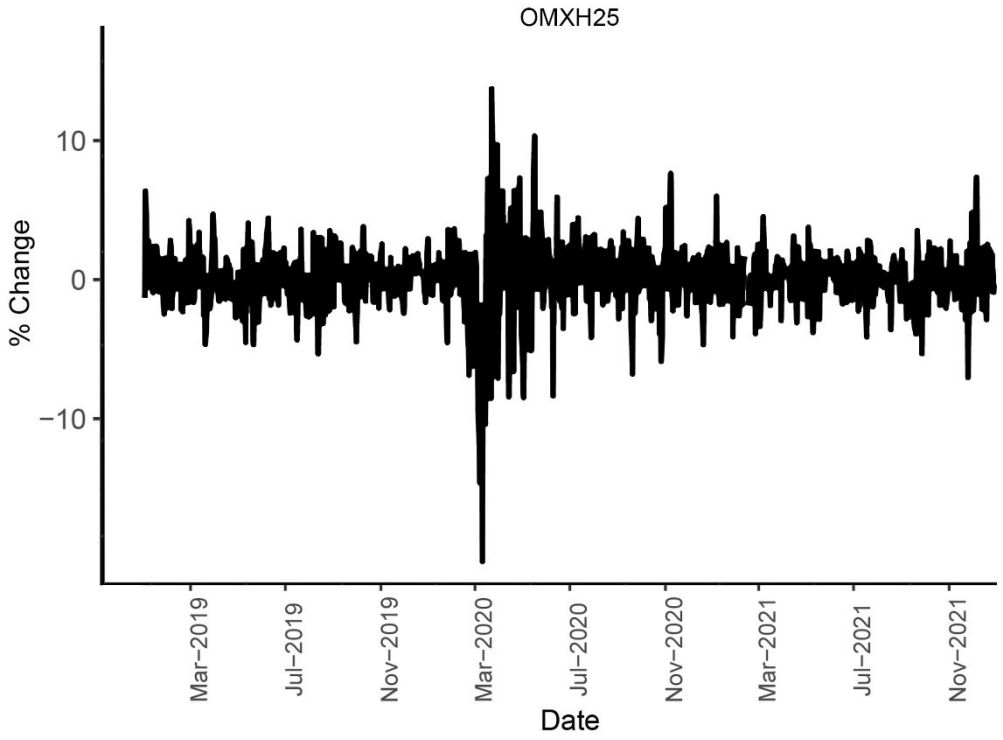

Figure 19. OMXH25 index histogram.

Figure 19 is an enlarged version of the previous OMXH25 index. Volatility spiked at the end of February and reached abnormal levels in March 2020. Compared to the 10-year median, March volatility was five times higher as the highest. (Yahoo Finance, 2022) After March, volatility continued spiking - disputable because of the news entering the market. It can be identified that volatility spikes in the above plot shrink over time, indicating that practical experience and increasing knowledge of previous news, and those effects on the market, remove uncertainty and raise investors' self-esteem decreasing volatility as the diminishing herd reacts to the news. At the end of the whole period, volatility is seen rising, which correlates with the time as concerns of the new COVID-19 variant raised and was linked to declining of the stocks.

According to consensus, herd behaviour is seen to be timely connected to financial markets volatility, bubbles, and crises. According to Baddeley (2013, p. 214), herd behaviour

is endemic in financial markets, especially in uncertain times. Investors tend to copy other investors' decisions instead of basing their acts on the fundamental value of the securities, this creates speculative price bubbles. In the next chapter, the impact of news on the stock exchange rates is researched as they could trigger herding and other behavioural biases.

4.4 Stocks response to news

Several (Naveed et al., 2022; Basuony et al., 2021) research has connected stock market performance with COVID-19 related news published. The significant events and news presented in Table 5 are compared to the market developments to understand how and if the news also affected these export companies' stocks.

No.	Event	Date
1.	WHO/Europe receives notice of a cluster of cases of atypical pneumonia in China (WHOa, 2020)	31.12.2019
2.	The first news stories on the novel coronavirus are shared with Members States and the public (WHO, 2020a)	10.1.2020
3.	First cases of the novel coronavirus in the WHO European Region are confirmed in France (WHO, 2020a)	24.1.2020
4.	The first cases of the novel coronavirus are confirmed in Germany (WHO, 2020a)	28.1.2020
5.	The first case of novel coronavirus confirmed in Finland (WHO, 2020a)	29.1.2020
6.	The disease caused by the novel coronavirus is named COVID-19 (WHO, 2020a)	11.2.2020
7.	The rapid spread of COVID-19 detected in Northern Italy (WHO, 2020)	22.2.2020
8.	OPEC's pact with Russia falls apart, sending oil into tailspin (Reuters, 2020)	6.3.2020
9.	WHO assesses that the COVID-19 the outbreak is a pandemic (WHO, 2020b)	11.3.2020
10.	USA declares European travel ban (BBC, 2020)	12.3.2020
11.	Lockdowns and restrictions on international travel begin across Europe (YLE, 2020a)	16.3.2020
12.	Finnish government forces acts from the crisis legislation in use (Finnish Government, 2020)	17.3.2020

No.	Event	Date
13.	The Finnish government promises billion euros in subsidies for struggling companies (YLE, 2020c)	26.3.2020
14.	WHO/Europe shares guidance for countries and areas on reducing the adverse financial effects of the pandemic (WHO, 2020a)	22.4.2020
15.	The Finnish technology industry is in crisis, reporting the lowest invitations for tenders in April since the financial crisis (TS, 2020)	29.4.2020
16.	The Finnish government announces a hybrid strategy in order to keep the country and economy open (Valtioneuvosto, 2020)	6.5.2020
17.	The Finnish government has decided to offer business cost support to businesses (Iltalehti, 2020)	14.5.2020
18.	The Finnish government declares the end of emergency conditions (Ilta-Sanomat 2020a)	15.6.2020
19.	The second wave of the pandemic hits Finland (HS, 2020)	1.9.2020
20.	First vaccines arrives in Finland (YLE, 2020c)	26.12.2020
21.	Third wave of the pandemic hits Finland (HS, 2021)	1.2.2021
22.	New variant in Finland (YLE, 2021a)	17.2.2021
23.	Finland announces a state of emergency (Valtioneuvosto, 2021)	1.3.2021
24.	Finland opens commuter traffic from EU and Schengen countries (YLE, 2021a)	15.6.2021
25.	Fourth wave of the pandemic hits Finland (Salminen, M. 2021)	20.7.2021
26.	The fourth wave settles down (Keusote, 2021)	15.9.2021
27.	New variant found in South-Africa (Callaway, E. 2021)	22.11.2021

These news are numbered 1 to 27 and added over the chart below as red lines, they were selected after wide research from different sources, studies that listed significant events during the pandemic, and national news that spread from several news outlets, reaching the major public. Before extracting stock data, the news were chosen to avoid result distortion and researcher bias.

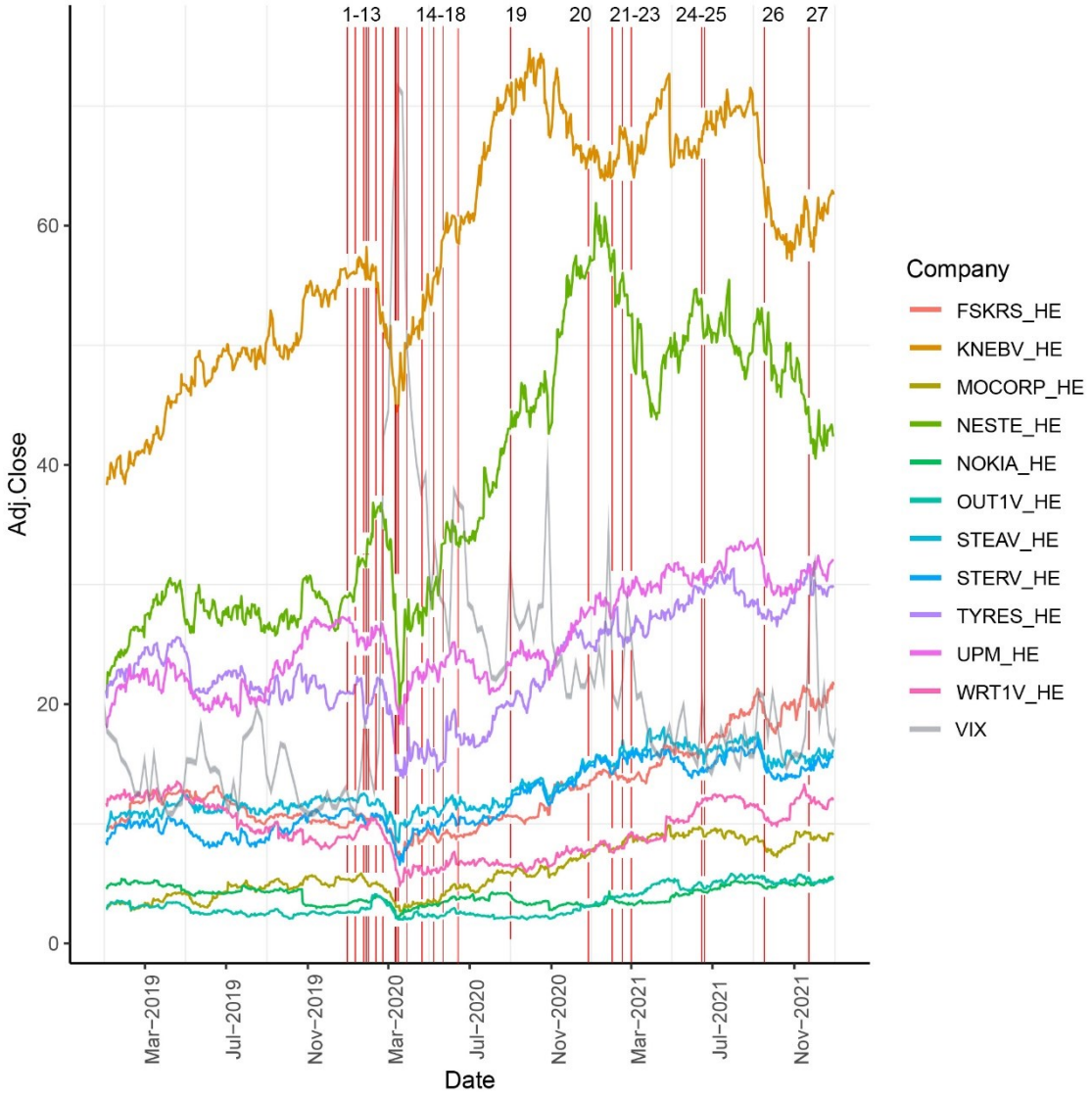

Figure 20. Line chart with the news.

A notable amount of news was placed in springtime in the year 2020. Figure 20 presents stock values and the VIX index from the beginning of 2019 to the end of 2021. The X-axis presents the date, and the Y-axis adjusted closing prices. As the chart was resized to fit on this page, this chapter progresses chronologically and numerically, referring to the notable changes in the stock exchange rates and looking for temporal connections to the news. The number of related news is marked as superscript in the text.

As WHO announced a cluster of cases of atypical pneumonia in China[1], and the first news stories were shared in public[2], there were no notable movements in the stock prices, referring that the first news[2] of COVID-19 did not affect investors' decision making. Stocks seem to start correlating at the end of January, as the first cases were confirmed in France[3], causing a decline in nearly every company's stock. This was followed by the announcement of singular cases around Europe[4], including Finland on Wednesday 29th of January. On the next Monday 3rd of February, Kone, Nokia and Wärtsilä started declining. The disease caused by the novel coronavirus was named COVID-196 on 11th, in the previous day, Monday the 10th, Nokian Tyres, Outokumpu, Storaenso and OMXH25 index had started declining. The VIX index rose momentarily to 20, and a week after Fiskars, Neste and UPM also started to decline. But despite these news and declines, stocks generally fluctuated between the level they were when the first announcement from France came[2] on the 24th of February.

As concluding this slowly phased decline wave, it started after the first cases in Finland were noted and herd grew in every following Monday, as singular COVID-19 cases rose around Europe. Uncertainty grew as declines only continued even though nothing major had taken place. Tension began to build, causing rising volatility. Professional investors more than likely recognised the characteristics of a stock market crash, including negative sentiment, a decline in share prices, declines in major indexes and an increase in margin calls (CMC, n.d.; Mahata, et al., 2021). Investors began to postpone trades due to uncertainty about the situation, leading to financial contagion. The observed decrease in stock returns specifically on Mondays can be attributed partially to the Weekend Effect, a well-documented phenomenon in financial markets. It has been noted that returns on Mondays are significantly lower than on the preceding Friday. The phenomenon is based on Frank Cross's report *"The Behavior of Stock Prices on Fridays and Mondays"* (1973).

As this relatively placid economic domino-effect continued, three weeks later the most notable event befallen on 22.2.2020, as the rapid spread of COVID-19 was detected in northern Italy[7], and all stocks collapsed as synchronised. At this point, investors realised

how unstable the situation was, and the epidemic was turning into a pandemic. As uncertainty took over and no notable nor informative news was released during the next two weeks, investors' uneasiness provided space for irrational investor behaviour. Even the event on 6.3.2020, when oil prices plunged over 10% as OPEC's pact with Russia felt a part[8], did not ease the pressure on the market.

On 12.3.2020, the USA decreased the European travel ban[10], and on the previous day, the WHO assessed that the COVID-19 outbreak was a pandemic.[9] This was followed by lockdowns and restrictions on international travel across Europe.[11] While news outlets were filled daily with unpleasant news, stocks turned almost to a free fall. Panic and uncertainty gripped the market. On 16th March, the VIX index reached an all-time high daily close value of 82.69. The next day, the Finnish government announced that acts from the crisis's legislation will be forced, adding more fear to the market.[12]

After one-and-a-half-week, governments started to announce subsidy plans for companies.[13] Among others, on 26.3.2020 Finnish government promised billion euros for struggling companies, and stocks started to recover. A month later, this was followed by WHO's guidance for countries and areas on reducing the adverse financial effects of the pandemic.[14] The Finnish technology industry announced on 28.4.2020 that requests for tenders plummeted, and exports were expected to bottom out towards the end of the year.[15] The level of tender requests dropped to its lowest since the weakest quarter of the Financial Crisis, leading to a moderate drop in the stocks.

On 6.5.2020 Finnish government announcement of a hybrid strategy to keep the country and economy open.[16] A week later, the Finnish government decided to offer business cost support.[17] Stocks seem to react positively for both. Emergency conditions in Finland were declared over on 15.6.2020, boosting the recovery.[18]

This was followed by a relatable slow three months news season. The second wave of the pandemic started strengthening in Finland at the beginning of September 2020.[19.]

Following that there can be detected several V-shaped declines and VIX-index took a sharp rise. The second wave was strongest during November 2020. The first vaccines arrived in Finland on 26.12.2020,[20]. The market reacted positively to this announcement as vaccines were a tangible sign that uncertainty was receding, it created hope that the situation would be brought under control.

As the year 2021 began, 1.2.2021–1.3.2021, the third wave was officially announced in Finland[21], and the new local variant was found[22] leading to Finland's announcement of a state of emergency.[23] Especially the announcement of the new variant seems to cause a slight drop in the stocks. After that, stocks continued as volatile. As the odd high and very high positive correlation between Nokia, Fiskars and OMXH25 index was noticed in this period in the previous chapter, as previously correlation was negative and negligible, a closer look at these three is presented in Figure 21 below.

As the influence of news on market movements is indisputable, the effect of single news requires detailed research. As the stocks are correlating and highly volatile, individual news placing over a rise or decline of stocks is quite probable. Nevertheless, previous studies and this thesis have found that most markable findings were placed during the Fever period. At this time, the markets suffered a massive fall despite there being only a few news or new information available. However, those few news that offered awareness of uncertainty had a strong effect. Correlation changes from positive to negative between Nokia, Fiskars and OMXH25 index was so peculiar that it is worth detailed research.

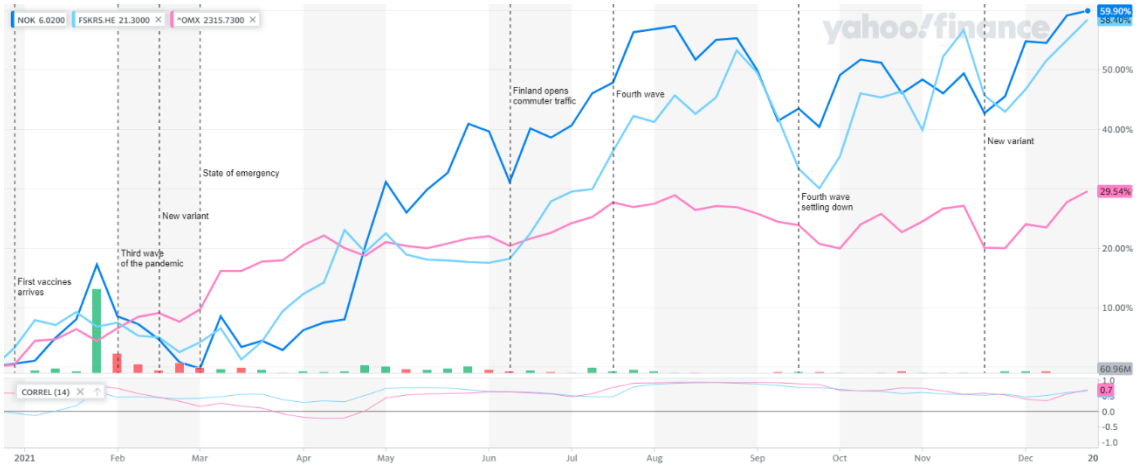

Figure 21. Line chart of Nokia, Fiskars and OMXH25 index (Yahoo Finance, 2023).

In the above chart, Figure 21, the blue line presents Nokia, the light blue line Fiskars and the pink line presents OMXH25 index. The X-axis is a time period of 26.12.2020–30.12.2021, and the Y-axis presents a percentage change. The news/events no. 20.–27. are marked with vertical lines. A unifying factor for correlations seems to be a response to events, which still does not explain why Nokia started correlating among others again since it had detached in the last period. Although, this close up displays explosive growth in the volume of Nokia's stocks on the 25th of January and a price increase of 13 percent. More detailed research of this event reveals a connection to the GameStop short squeeze, a phenomenon where discussion board users built the foundation for the short squeeze, succeeding in increasing the stock price by 1 500 percent. The same move was tried to be repeated with Nokia's shares, thus a sudden rise in share price. This increased share turnover, brought in new shareholders, and increased the company's interest and media presence, presumably making the stocks of Nokia more susceptible to the effects of news. (Marketwatch, 2021; Talouselämä, 2021; HS Talous, 2021; Financial Times, 2021; Washington Post, 2021; Yahoo Stocks, 2021)

On 20.7.2021, the fourth wave of COVID-19 was announced in the news,[25] there are some small correlative V-shapes, but nothing striking. After the fourth wave was announced to be settling down, 15.9.2021, the stocks started recovering until 22.11.2021 when the news outlets announced information about the new variant found in South

Africa.[27] There was a notable decline, which could be caused by the sensationalist news that this variant could be potentially threatening compared to the previous variants. Additionally, the VIX index rose suddenly to 30.67, surpassing 30.00 for the first time that year, previous rises had been 30% smaller.

In conclusion, the end of February to the end of March was the most active time, this was the period Ramelli & Wagner named as Fever period. Thogh, as this thesis proves, the period continued further in Finland and began earlier than their global research implies.

VIX index did not fall below 20 till the end of March 2021, which indicates continuous market stress. Stocks had a strong correlation of at least 6.5.2020. A turning point for the stocks was on 16.–23.3.2020. VIX-index was at its highest level, stock market nearly stagnant, and share values were at their lowest. It can be reasoned that government subsidies triggered the situation and increased share rates. In the USA, The White House decided on a $2 trillion stimulus bill to combat the economic impact of the coronavirus outbreak (CNN, 2020), and in Finland government announced one billion euros to be shared for companies (YLE, 2020b).

After this, there is a clear pattern, as the 2nd- and 3rd -waves starts and when the South-African variant was announced. Markets react strongly but recovers quickly, followed by a short period of instability, as new and more detailed information became available, and investors sensed that the situation was worsening or getting better. It can be claimed that fear controlled the market.

4.5 The impact of investor behavior on the market

The market movements were massive by reviewing the market and stock development during this period, and according to research (Baldwin & Weder di Mauro, 2020; Carlsson-Szlezak et al., 2020), mostly separated from the real economy. News and information

drove markets, but research by Davis et al. (2020) concluded that those could only explain part of the change in the returns. As brought out in the literature review of this thesis, among others, Nofsinger (2018, p. 2) has suggested that emotions and psychological biases could considerably influence investors' decisions during times of high volatility. Therefore, to conclude this research, this chapter answers the sub-question, *Can the effects be explained by behavioural finance?*

Based on the stock movements, the market predicted the real economy outcomes of COVID-19 as the stocks in Finland started to decline on the week six, and had a substantial decline on 24th of February, on the week 8. Continuing to decline almost as a free fall, due to the series of negative news. The situation stabilised during the week 12. As stated, it is arguable that only the news would have affected and caused the fall, as there are many variables, but the impact of major events can be clearly stated. Although the news of 6.3. in week 10, as OPEC's pact with Russia fell apart and declined oil prices by 10%, it was a significant event on the financial market, and according to general assumption, would have been assumed to lead to positive reception on the market. Still, it did not seem to have a considerable effect. Researchers Peascatori and Mowry (2008) from the Federal Reserve Bank of Cleveland have discovered otherwise about this widely recognised causality. Their research points out that the joint inference that there is a correlation between oil price and stock market prices is not entirely accurate. They suggest that analysts cannot certainly predict the stock reaction to changing oil prices. Although, this magnitude of decrease in the oil price should have been in a rational manner affect especially export companies' stock prices. Despite that, not even Neste's share prices flinched. Uncertainty and fear in the market were greater than this event to have an effect. Thus, it can be debated that uncertainty in the market has strengthened the decline by increasing irrational investor behaviour.

As a previous study (Ramelli & Wagner, 2020) discovered, there is substantial evidence of investors' fear of COVID-19 turning into a financial crisis, likewise the situation raised concern over cash holdings and corporate debt. Hence investor's reaction was linked to

a substantial market decline as news from Italy surfaced. Furthermore, the study concluded that as the decline and whipsaw pattern of accumulated returns sustained despite no novel information flooding the market, investors might have grasped by herding behaviour. As the uncertainty period kept stretching, the herd kept growing. A primary factor in herding is that investors start to respond quickly to news, react to insignificant news and act short-sighted (Graham, 1949), which is reasonable to assume that happened during the first weeks - investors were influenced by the mass of insignificant news, of daily infections rate, an educated guesses by several specialists, et cetera.

As emotions have been researched to influence on investor behaviour (Jlassi et al., 2013), and negative news are correlated with negative stock market performance, it is logical to link the March freefall of stock and the influence of a flood of bad news in this period. The March freefall was a result of an uncertainty shock that had destabilised investors' confidence leading to a sentiment shock, turning stocks into a strong decline, which was then strengthened by negative news. Herding behaviour fostered the effect, possibly boosting underlying behavioural biases that enhanced irrational investor behaviour.

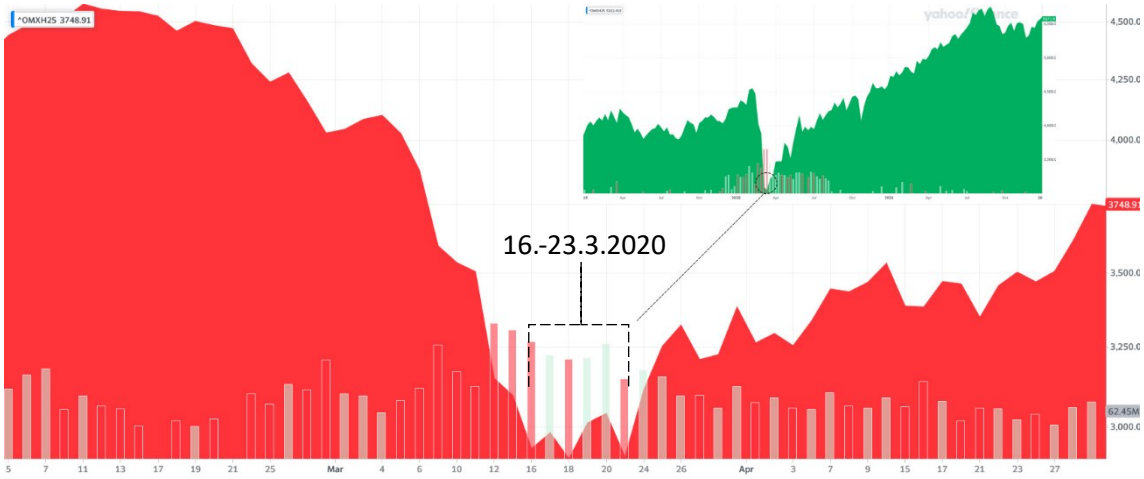

Figure 22. OMXH25 index, 16.–23.3.2020 (Yahoo Finance, 2022).

As stated before, the turning point for the market was 16.–23.3.2020, when the stock market was almost stagnant and in market equilibrium. Figure 22 presents the OMXH25 index during this period. The X-axis presents day, the Y-axis price, and the vertical bars

represent the relative trading volumes in one day period, the green chart is the same index from the whole observation period to frame the decline into perspective. The perfect market equilibrium can be observed on days 17.–19.3.2020, Tuesday to Thursday, during the whole week price fluctuation was so minimal that it caused virtually a stagnancy period. At the same time, the VIX index reached its all-time high, it is fair to state that investors were too insecure to trade. Similar behaviour was seen in the time of the financial crisis in 2008 (McKeever, 2020).

Uncertainty fed risk-aversion among investors, as they hold familiar stocks despite not being the rational choice due to familiarity bias, investors implemented loss aversive behaviour. Moreover, it was challenging for investors not to fall on cognitive biases such as confirmation bias, which highlights negative news and further dampens the market mood. They should also avoid anchoring bias, which values stocks based on recent prices, and recency bias, which assumes that the decline will continue as it has for several weeks.

As can be detected from the chart and volatility plots, market stayed volatile for an extended period after the March free fall. Recency bias was seen continuing at the end of the research period, as every time there was a significant announcement of the COVID-19 state, stocks declined. Investors overemphasised these announcements, misleading to believe that a major decline in share values would occur again. However, movements decreased over time as the investors started to gain more precise information, and uncertainty diminished along with other biases.

5 Conclusions and summary of the research

This thesis aimed to investigate the impact of COVID-19 on the stock market performance of Finnish export companies and to expand understanding of investor behaviour during COVID-19. To achieve this primary objective, general effects and theories related to the topic were reviewed in the literature review. After this, an empirical study was conducted, the aim of that was to study the topic in more detail and fill a research gap by extending the observation period, as well as reveal new country-specific data. The empirical part was divided into two sub-questions, *How did this crisis affect the stock prices of Finland's ten biggest export companies?* and *Can the effects be explained by behavioural finance?* The research conducted on the topic was approached through four complementary methods, which included analysing the overall impact on the stock chart, examining correlations between different companies, assessing volatility, and evaluating the influence of news. The use of multiple angles and by cross-referencing the findings from each research approach, a comprehensive understanding of the topic was achieved. It was imperative for obtaining reliable and accurate results.

COVID-19 clearly affected the Finnish export companies' stock market performance, but it was comparatively short-lived. This study found that the decline for the companies examined began gradually on February 3, 2020, and persisted beyond the timeframe defined by Ramelli and Wagner (2020) for the Fever period. This research demonstrated that share prices were detached from fundamental value, as extraordinary risk impacted the market, stocks started to correlate, creating a contagion effect, and transferring risks through the stock markets. The most blinding event was the March free fall, as the whole stock market declined globally. It resulted in a significant correlation between researched companies' share values, the shares moved in an average tandem for almost a month. After that, correlations continued fading to the end of 2021, demonstrating a lengthy contagion effect.

This thesis made a surprising discovery: Companies improved their stock prices drastically in short order after the first wave of COVID-19, compared to the Pre-Pandemic era.

The lowest increase from the March free fall was on Kone, by +67%, and the highest increase was on Outokumpu and Fiskars, by 186% and 183%. This clearly demonstrates that the adverse effects of COVID-19 on researched companies' stock values were temporary.

As investigating the OMXH25 index, against the hypothesis, these companies did not suffer more than the general development. On the other hand, the shock was so brief that adverse effects on export markets did not accumulate to the extent that these companies would not have had the capacity to return to normal apace. Undoubtedly, the situation depends on the company and the countries it exports.

Conversely, from the viewpoint of overall exports, the majority of Finland's' exports go to Europe. Therefore, there are only a few bottlenecks for outgoing transport, due a comprehensive and smooth road network after crossing the Gulf of Finland. Hence, disruptions in the supply chain have a greater impact on imports, resulting in a shortage of raw materials. In that case, the amount of stock determines how long a company can manage without a stock replenishment. However, companies need to keep the inventory turnover as efficient as possible and the safety stock lean. As buffer stock increases, capital tied up in inventory is not available for other business needs, weakening the company's solvency, thus cutting the company's liquid capital. As in terms of the cost efficiency of a supply chain, it is essential to try to keep stock quantity as low as possible.

Hence, finding the right balance between too quantity and too small safety stock is essential. Inventory management requires as precise planning as possible, even under normal conditions. Thus, preparing for crises that suddenly affect supply chains is challenging. Therefore, conducting this type of research is also essential for logistics and risk management. When the hallmarks of various crises are identified, more accurate assessments can be made.

As the results of this research about volatility indicate, through the research period it was substantial and highlighted the uncertainty. The trend showed that the most variation in the stock prices timed in March 2020. Autumns and news of new waves temporarily increased volatility. Although the impact on stock prices was swift and comparable scarce in the long run, the overall effect on Finland's goods export was more substantial, as total value declined 12 percent. Nonetheless, lost exports were balanced the following year as the total value of goods exports increased by 19.4%, amounting 11 billion euros increase.

Given that the stock market decline was steep, observing it from a broader perspective is beneficial. There had been a long and robust market rise over the past years, and valuations were high at initial levels, thus, the downward trend was greater. Though high valuations do not indicate that a correction move is coming, a long period of rise increases the pressure and anticipation for a decline, COVID-19 was the trigger that markets had anticipated, presumably leading to overreaction. As results indicated, the decline was approximately equal for all, but the recovery was individually paced.

Companies needed to ensure uninterrupted production and communicate timely updates. Upon researching various companies, it was evident that each one had effectively managed crisis communication with investors. By maintaining an active communication channel, the companies were able to minimize uncertainty and respond promptly to the situation, enabling them to establish new strategies. The ability to adapt quickly proved to be an asset in navigating through the crisis. As well numerous companies proactively tackled supply chain challenges by procuring alternative suppliers from different countries and continents, thereby preventing any potential scarcity of raw materials. Besides, maintaining an adequate buffer proved to be a pivotal factor. The meticulousness of these companies enabled them to surmount any looming disruptions. As per the statements by the companies, they proactively prepared for the post-COVID-19 era, exploring potential markets and customers in unrestricted countries. Their efforts proved to be successful as evidenced e.g., by the recovery of their share values by the end of the

research period, surpassing even their pre-COVID-19 values. Overall, these companies demonstrated remarkable adaptability in navigating the situation. As this was unexpected, it would be worth investigating if exceeded expectations and unrealised fear of recession lead investors to overvalue stocks. On the other hand, as the crisis settled and stock trading returned to normal, brisk trading raised prices, at least temporarily.

This research confirms that positive news has less impact during an intensive period of crises. Even in later phases, stocks reacted negatively to most news, and positive news at most prevented stocks from declining. This behaviour goes together with the negativity bias, which refers to a human tendency to focus more on negative information than positive. It assists to stay aware of potential dangers and is believed to be an evolutionary adaptation. (Anderson, S. M., 1990; Moore, 2019) In the realm of finance, negative events tend to elicit swifter, stronger, and more enduring reactions from investors compared to positive ones.

Instead, government announcements of financial aid were substantial in halting the decline. Emphasizing confidence in the government's ability to get the situation under control and exhibiting that positive announcement from a sufficiently authoritative source is needed to overcome the negativity bias.

Availability and representative bias could have seen as slight declines in share prices, whenever a new variant or wave was reported. Investors overweighted information based on March free fall, expecting it to occur again. On the contrary, anchoring bias most likely influenced positively investment decisions if investors did not panic sell due to anchoring price to an arbitrary benchmark as a purchase price.

Further, this research indicates that in some periods' stocks did not move as expected and confirms the assumption that the stock market was not efficient all the time. For example, Nokia announced that this crisis would not affect them negatively but instead increase their trade. Nevertheless, Nokia's stock price continued correlating and

declining with others. Likewise, a significant decline in oil prices did not immediately affect Neste's share price, and it continued to decline correlating with other stocks.

The stock response to the news was not constantly immediate, and in certain instances, the response was irrational, as the previous example presents. Uncertainty feed herding behaviour which made markets' behaviour unpredictable, this caused predicting the market impossible for a rational asset pricing model and the financial theories that could explain rational behaviour. Highlighting the need for behaviour finance, which fulfils the gap of the irrational side.

Governments support packages had a crucial role in creating the atmosphere and trust of a market recovery, preventing bankruptcies, job losses, and the resulting depletion of human capital. By turning the declining stock market into growth after the March stagnancy. The apparent effect of the event-based news and COVID-19-related events on the stocks can be demonstrated by following the course of the pandemic on the stock line chart. The first shock, new waves, autumns flu seasons and announcement of the new variants can undoubtedly be placed on the chart based on correlated declines.

As multiple waves characterised this crisis, the correlation between the economy and infectious events diminished during the time, as observed from the graph's, recession shapes got smaller along with dwindling volatility. This research additionally shows that there were no permanently damaging effects on the researched companies' share values. The crisis did not lead to regress and did not significantly reduce demand, but instead postponed production and sales, which was shown as collective stock values and exports rising by the end of 2021.

Based on this thesis, it appears that the behavior of investors played a significant role in the crisis. The stock market was heavily influenced by fear and uncertainty, and it seemed that a herd mentality influenced many investors. The thesis also suggests that COVID-19's impact on the stock market was not solely due to the virus itself but largely

connected to how people reacted to the outbreak. The panic that ensued from the disease also spread to the stock market, and in hindsight, many of the assumptions and decisions made at the time were exaggerated. As it turned out, the worst fears did not come to realise, and the March free fall was more of an isolated incident. This crisis was further behavioural than an economic crisis and very different from a financial crisis. Even though temporal effects were similar, the effect remained at the level of an economic shock. The cause of the COVID-19 crisis was external to the economic system, and it passed relatively quickly, as the results of this thesis demonstrate. The crisis did not cause lasting economic damage.

For short-term investors, COVID-19 provided an opportunity to gain significant profit. Albeit there was a common fear of this crisis collapsing markets and leading to a recession. As for long-term investors, this surprisingly expeditious crise did have a barely minimal effect within the time period of this study. However, longer-term effects on the future remain unseen.

As markets have been booming since the 2007–2008 financial crisis, facing only smaller and swift crises and economic shocks such as COVID-19, the pressure is accumulating. Stocks cannot rise eternally. Financial aid from governments has been widely used to prevent crashes also before this, which on the other hand is manipulating the somewhat natural course of events, and the downside is that they may distort the real value of companies as those keep bailing out companies in a consecutive manner. Overcoming continuous small crises also increases investor confidence, which may lead to irrationality and overvaluation of shares, creating secondary conditions for a stock market bubble. Only a period without crises will reveal the unvarnished truth and a possible house of cards.

5.1 Suggestions for future research

As this research extended the research period to its end, due that the Russian invasion of Ukraine shocked markets again at the beginning of 2022 and mingled causes. Future research should strive for more detailed research. As the correlation seemed to be market-wide, other companies from different industries could be researched and aim to find clear deviances among industries or between goods and service exports. As stated in the research, it would also be interesting to research companies' real values over this period, as the aim to examine if stocks were overvalued after COVID-19 compared to the Pre-Pandemic era. Moreover, if there would be a reliable way to research long-term effects on the Finnish export market beyond the research period, it would be advantageous to know how the market has been impacted in the years since this research was conducted. As well as researching directly company related factors that contributed to the recovery of the researched companies' stock values, besides their successful crisis communication and adaptability.

As this thesis also researched if the impact on export companies would be more far-reaching than average and discovered that it was not - at least based on a share prices. Since, the length of the shock could affect this by not accumulating adverse effects in such a short period, which leaves a gap for further research. So, to examine if the length of a shock is proportional to the damage, to which extent it accumulates and how long export companies can handle a shock without cumulative damage. For example, as seen in the Evergreen case, only a six-day blockage in the Suez Canal, the centre of the global supply chain, dammed transportation overseas and froze nearly $9.6 billion daily in global trade. (Ghosh, 2021)

Stocks' response to the news could be executed in reverse order by looking for news and events that coincide with the increases and decreases of the stock market chart. This would help to recognise psychological biases, and news could be labelled as positives and negatives to seek patterns. As well, profit warnings and volumes of stocks, to a greater extent, could be added to observe when stocks are traded.

Through a novel approach to behavioural finance, researchers could gain insights into how new pre-investors have performed in the stock market following the crisis. With the investment craze that swept the nation during the pandemic, investment companies saw a surge in new investors (Massinen, 2021; Nasdaq, 2022). While the markets were significantly volatile, many of these investors were able to earn profits that may have seemed impossible under normal circumstances. These experiences probably distorted perceptions and reinforced biases for new pre-investors, which would be worth researching

Altogether, the COVID-19 crisis offers an enormous amount of material for studying investor behaviour. People worked at home, leisure activities were impossible, and the flood of news and thirst for information was unprecedented. Uncertainty was present everywhere and affected everything. Herding was present in everyday activities and decisions. Entirely establishing the basis for psychological decision-making with numerous variables, which transferred to the stock market.

Some specific questions for future research could be,

1. What are the potential longer-term effects of the COVID-19 crisis on the future of the stock market and the economy?
2. What were the specific strategies used by companies to adapt to the COVID-19 crisis?
3. How might future economic shocks or crises impact the stock market after experiencing COVID-19?
4. What is the stock market performance of individuals who began investing during the crisis?

The information and findings in this thesis are intended for research and information purposes only and are general in nature. Any information in this thesis should not be considered as financial advice. Every event in the financial market is individual and might differ drastically from previous ones. The thesis does not consider readers' objectives, needs or financial situation. Please note that historical and simulated returns do not guarantee future returns. The value of financial instruments can both rise and fall. There is a risk that you will not get your invested capital back. The author of this thesis is not a financial adviser.

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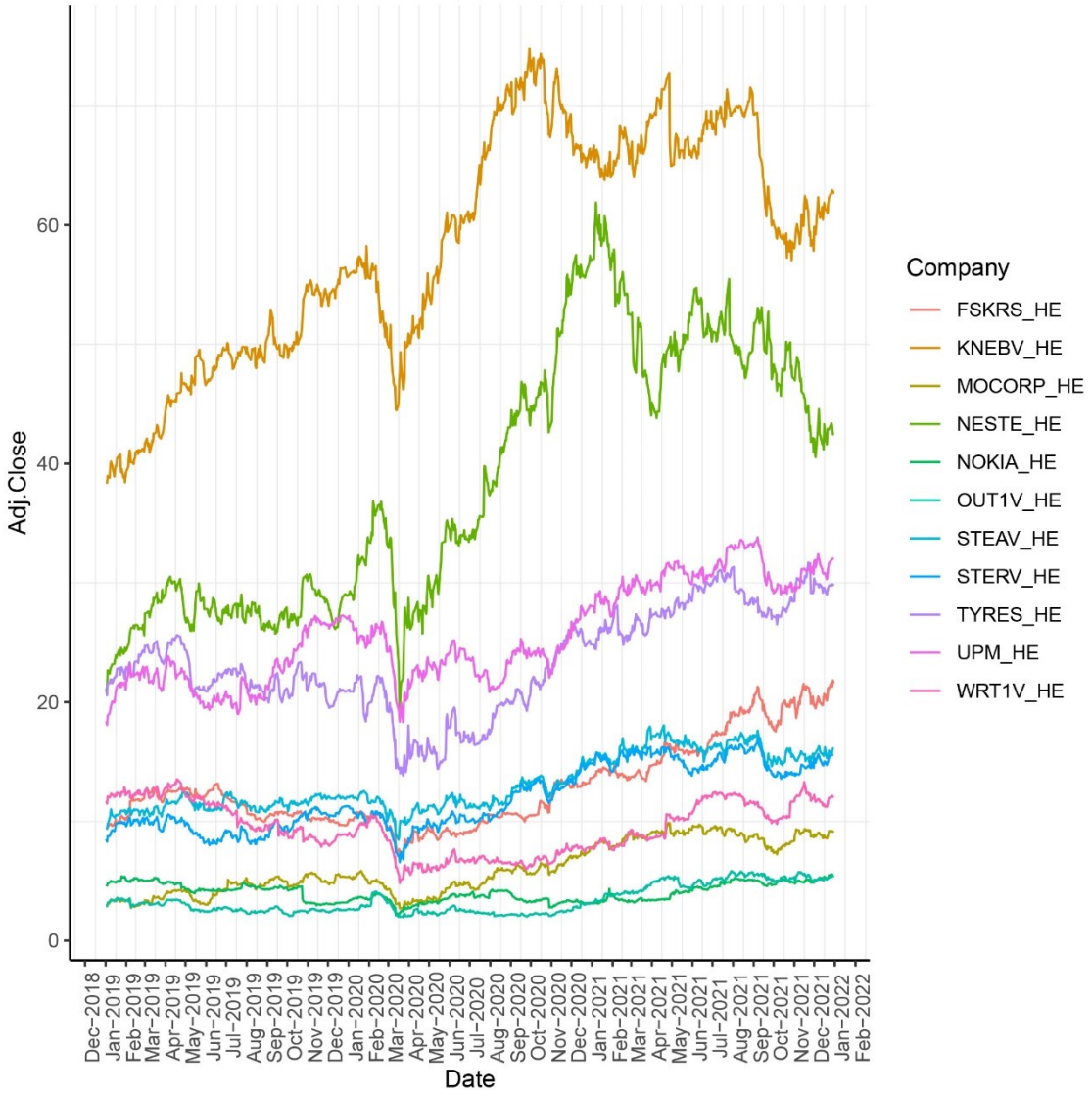
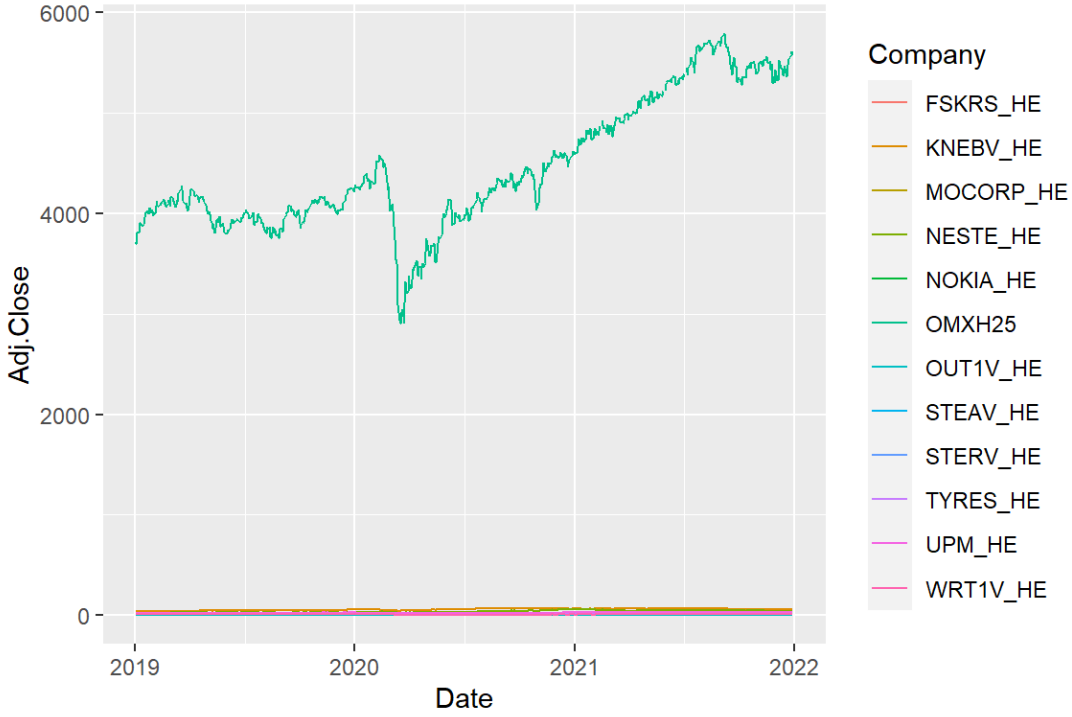
Appendices

Appendix 1. Overview of the companies' stock development, 2019-2021

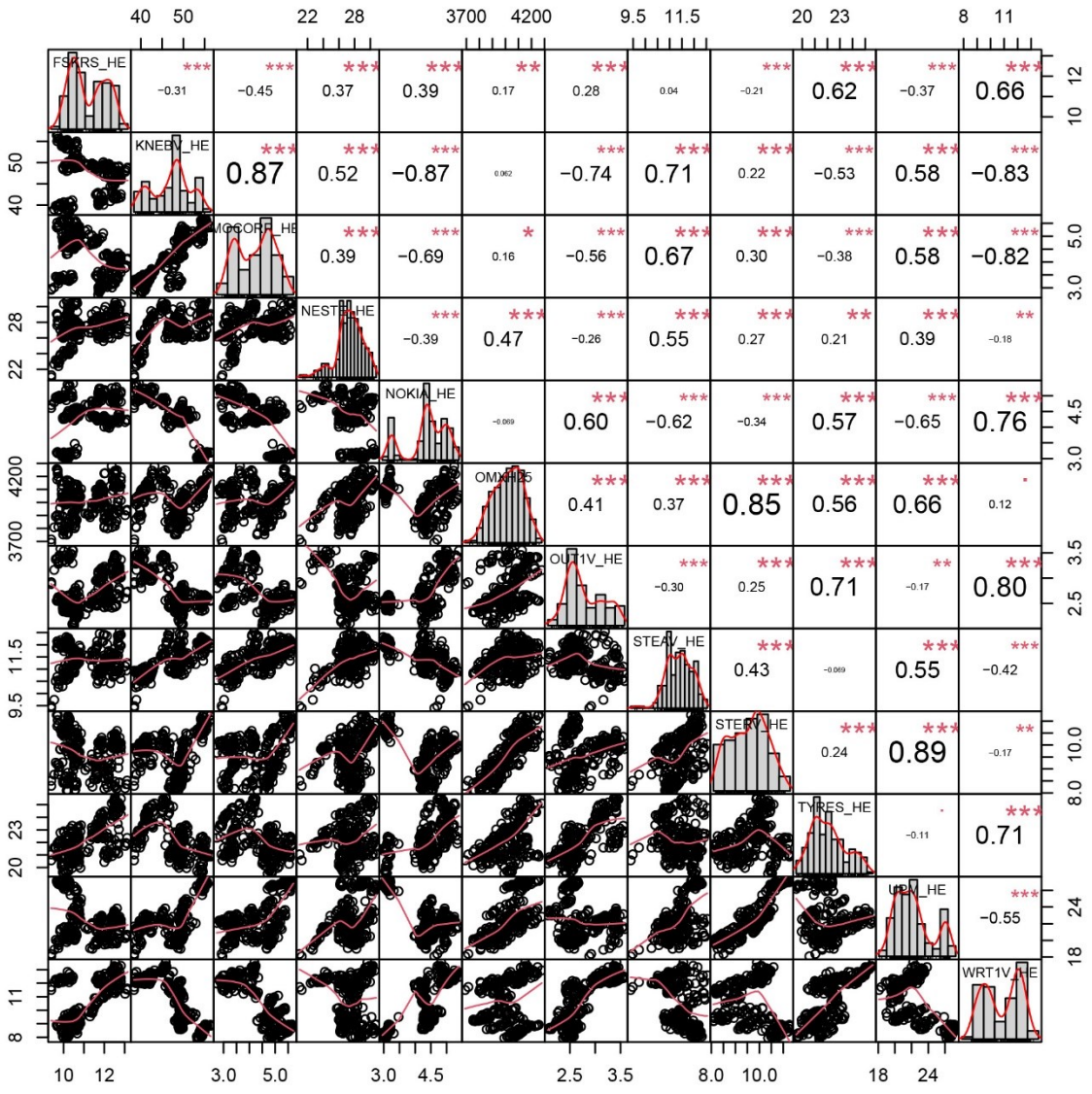


OMXH25 index

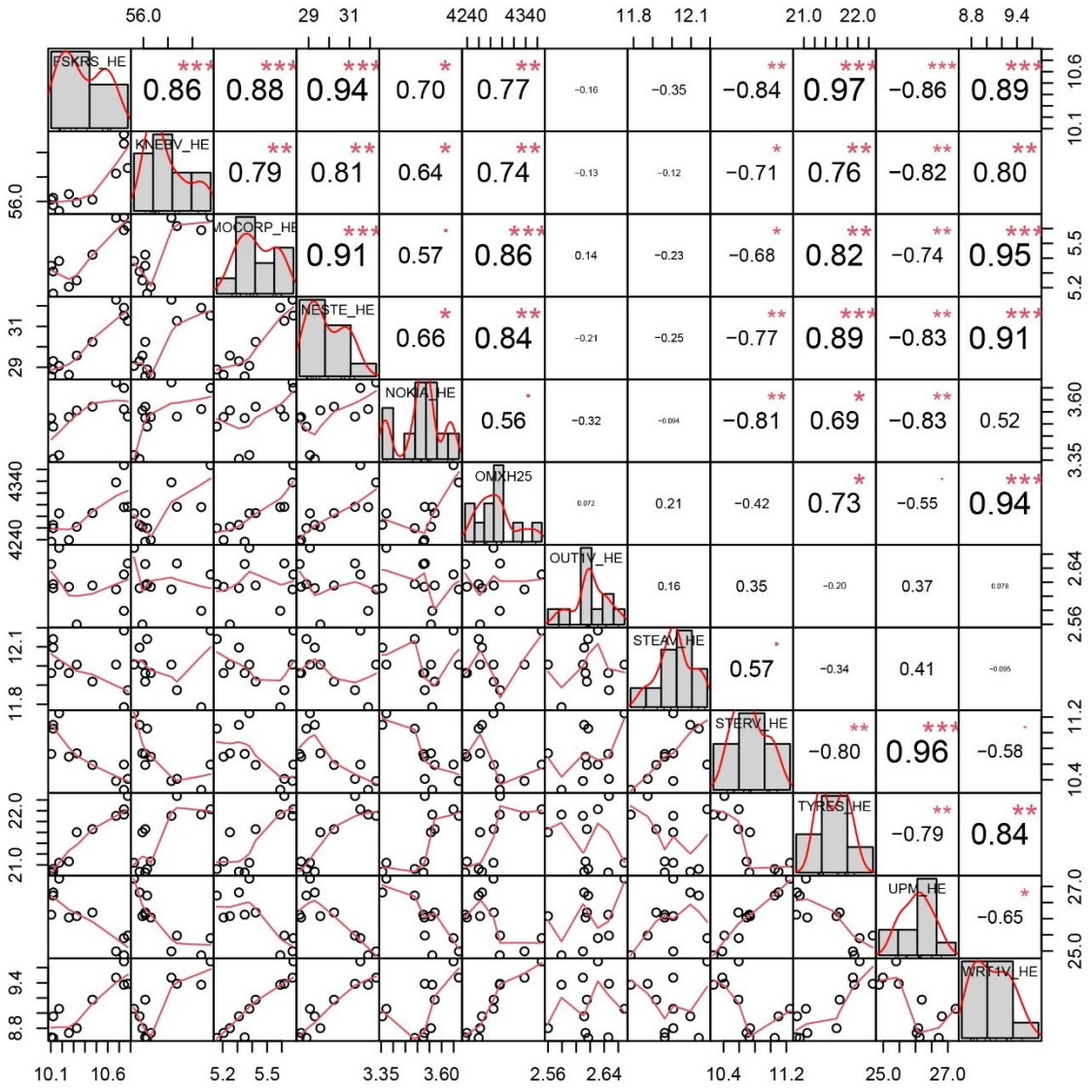


Appendix 2. Correlation matrixes

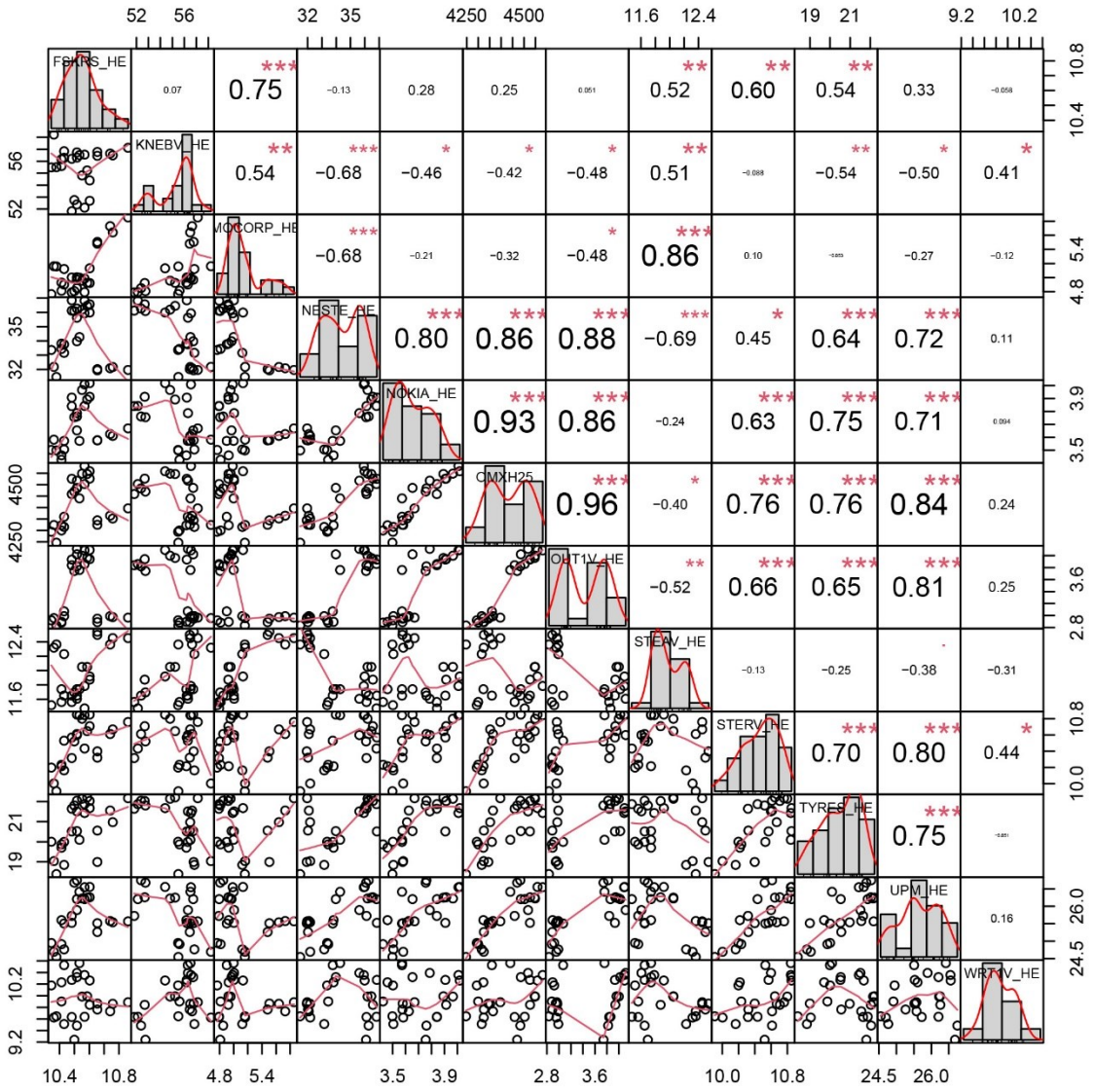
Pre-Pandemic era



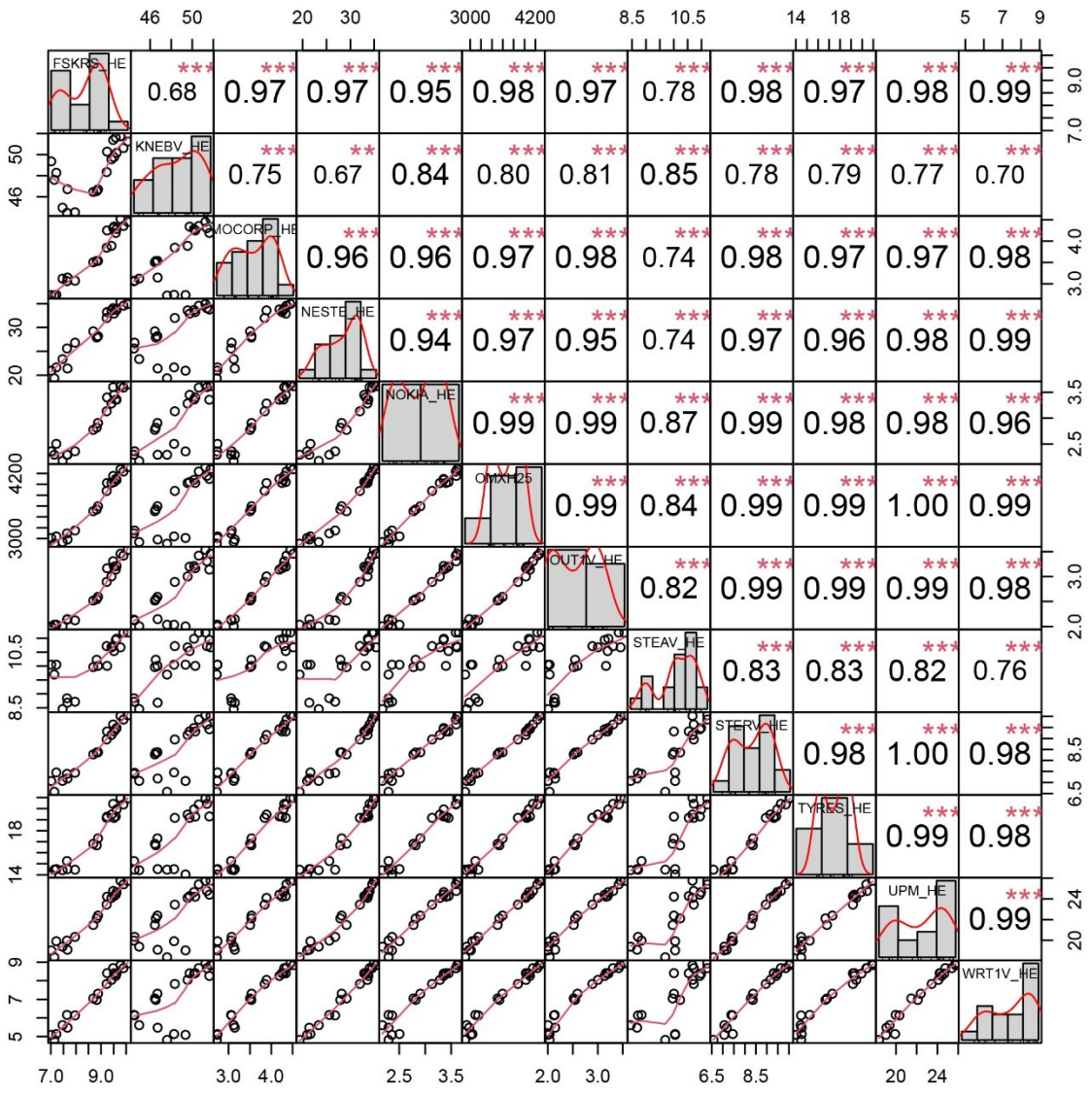
Incubation


FSKRS_HE
KNEBV_HE
MOCORP_HE
NESTE_HE
NOKIA_HE
OMXH25
OUTIV_HE
STEAV_HE
STERV_HE
TYRES_HE
UPM_HE
WRT1V_HE
0.86
0.88
0.94
0.70
0.77
−0.16
−0.35
−0.84
0.97
−0.86
0.89
0.79
0.81
0.64
0.74
−0.13
−0.12
−0.71
0.76
−0.82
0.80
0.91
0.57
0.86
0.14
−0.23
−0.68
0.82
−0.74
0.95
0.66
0.84
−0.21
−0.25
−0.77
0.89
−0.83
0.91
0.56
−0.32
−0.81
0.69
−0.83
0.52
0.21
−0.42
0.73
−0.55
0.94
0.16
0.35
−0.20
0.37
0.57
−0.34
0.41
−0.80
0.96
−0.58
−0.79
0.84
−0.65

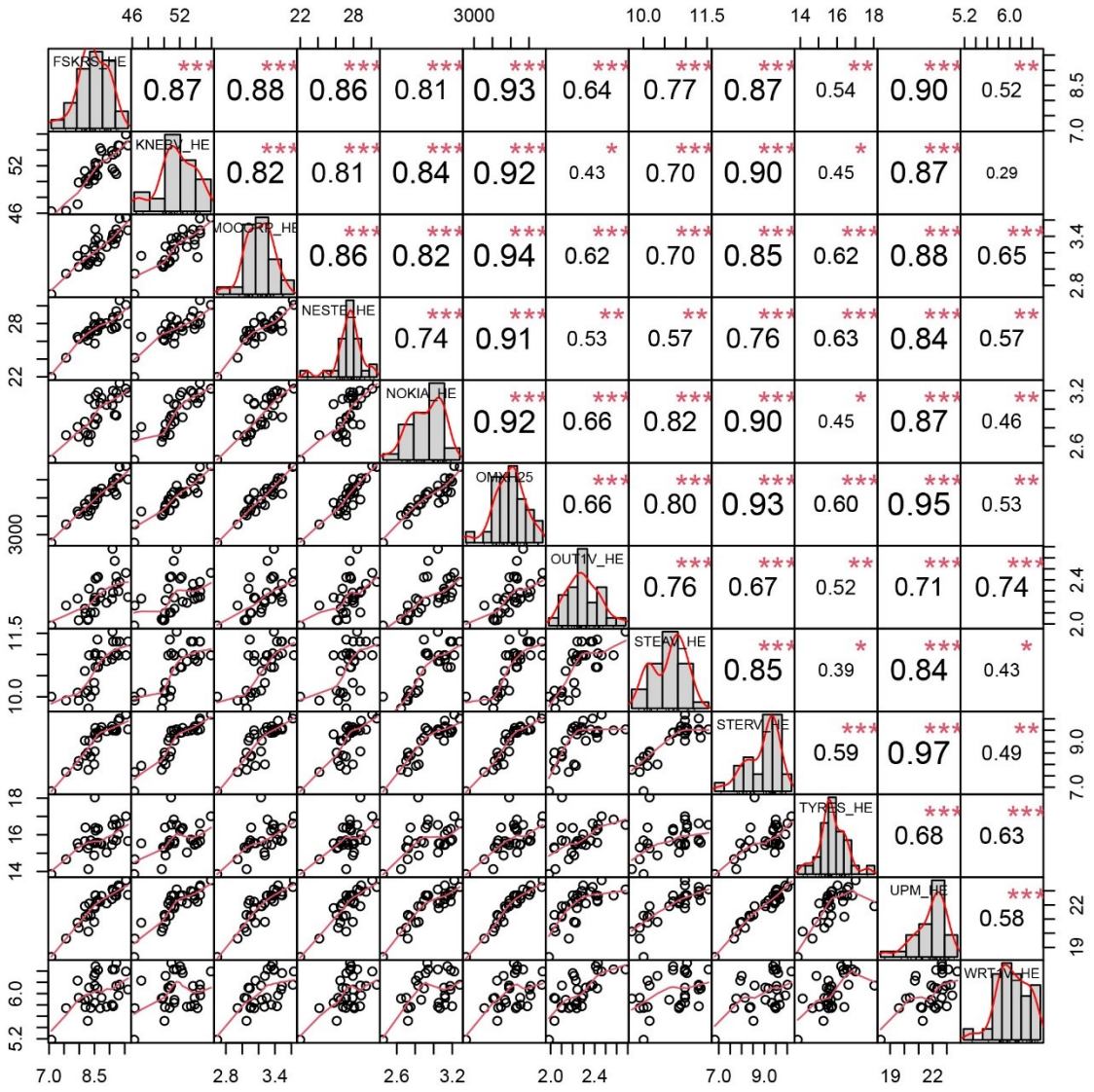
Outbreak


FORRS_HE
KNEBV_HE
MOCORP_HE
NESTE_HE
NOKIA_HE
OMXH25
OUT1V_HE
STEAV_HE
STERV_HE
TYRES_HE
UPM_HE
WRT1V_HE

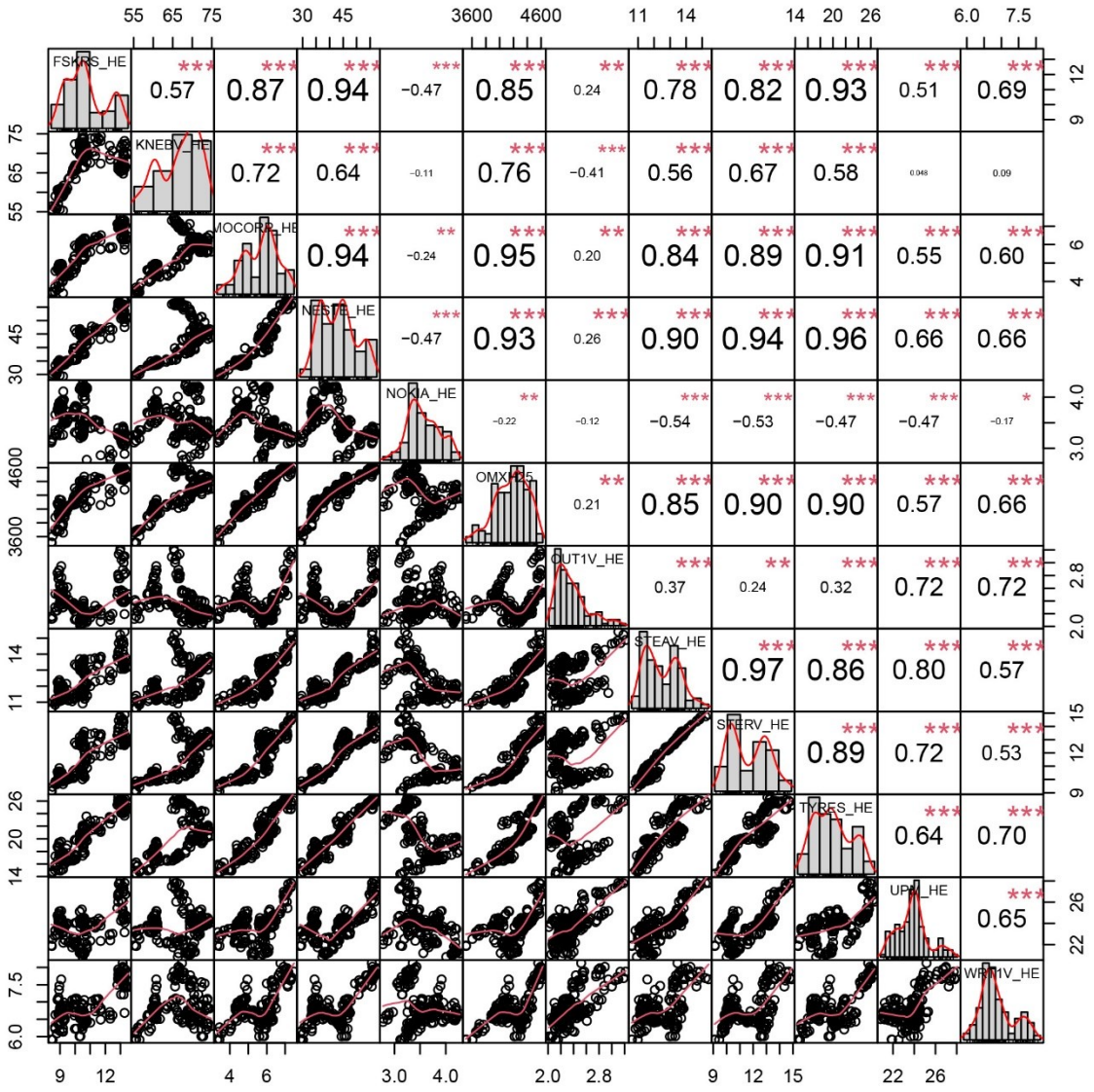
Fever


FSKRS_HE
KNEBV_HE
MOCORP_HE
NESTE_HE
NOKIA_HE
OMXH25
OUT1V_HE
STEAV_HE
STERV_HE
TYRES_HE
UPM_HE
WRT1V_HE
0.68 0.97 0.97 0.95 0.98 0.97 0.78 0.98 0.97 0.98 0.99
0.75 0.67 0.84 0.80 0.81 0.85 0.78 0.79 0.77 0.70
0.96 0.96 0.97 0.98 0.74 0.98 0.97 0.97 0.98
0.94 0.97 0.95 0.74 0.97 0.96 0.98 0.99
0.99 0.99 0.87 0.99 0.98 0.98 0.96
0.99 0.84 0.99 0.99 1.00 0.99
0.82 0.99 0.99 0.99 0.98
0.83 0.83 0.82 0.76
0.98 1.00 0.98
0.99 0.98
0.99

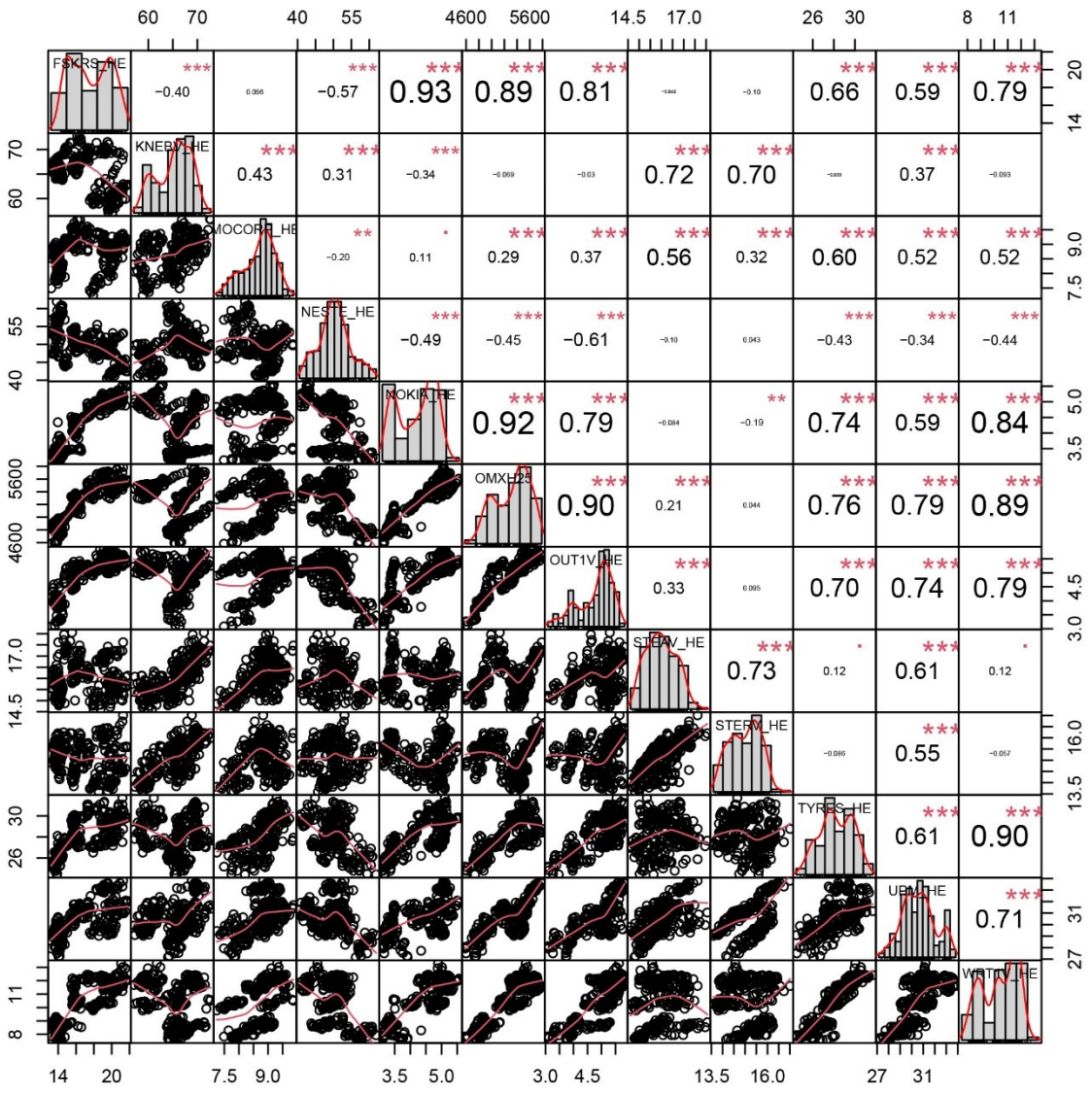
Uncertainty



Adaption

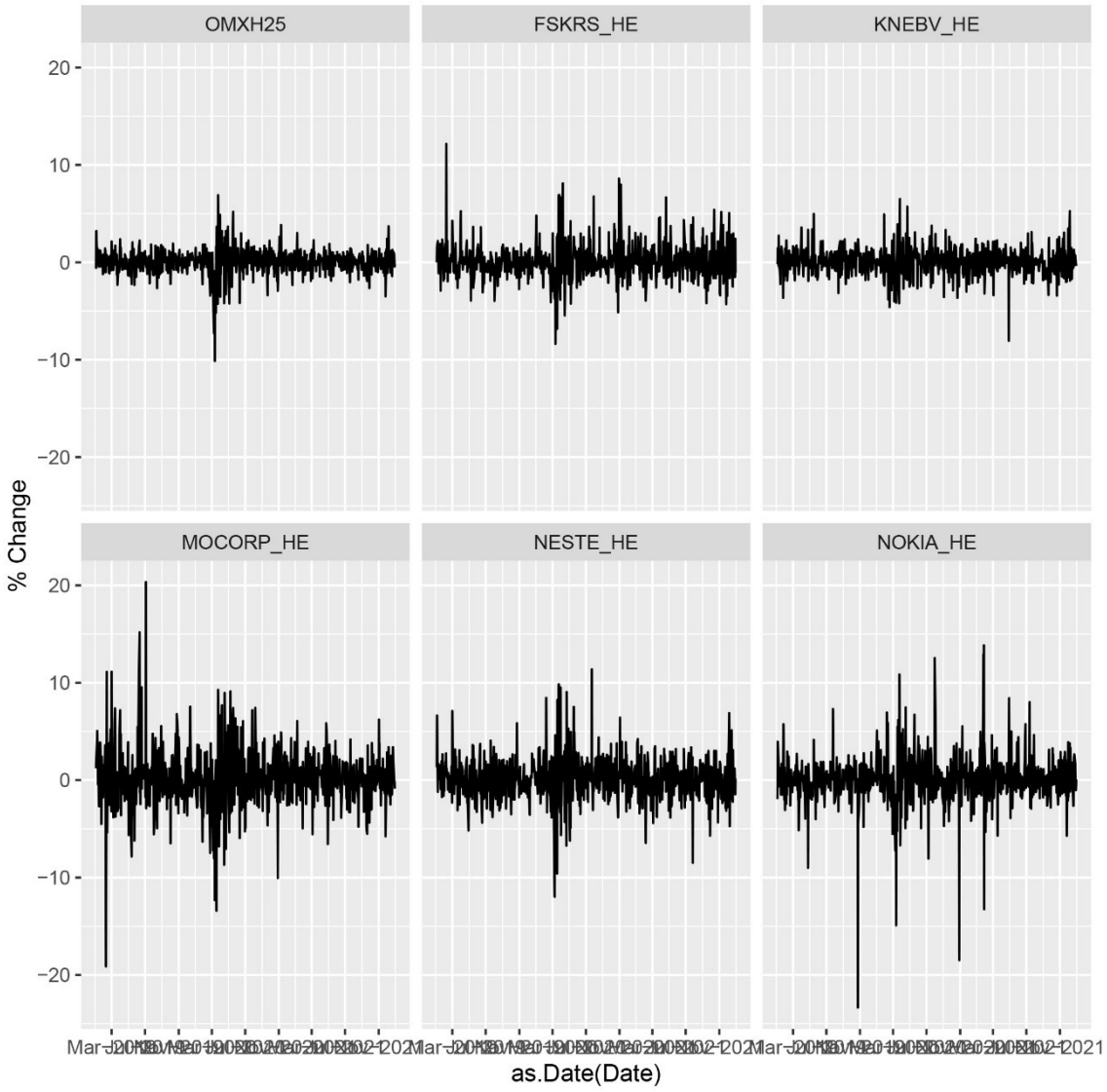

FSKRS_HE
KNEBV_HE
MOCORA_HE
NESTE_HE
NOKIA_HE
OMXH25
OUT1V_HE
STEAV_HE
SRERV_HE
TYRES_HE
UPM_HE
WRT1V_HE

New Normal

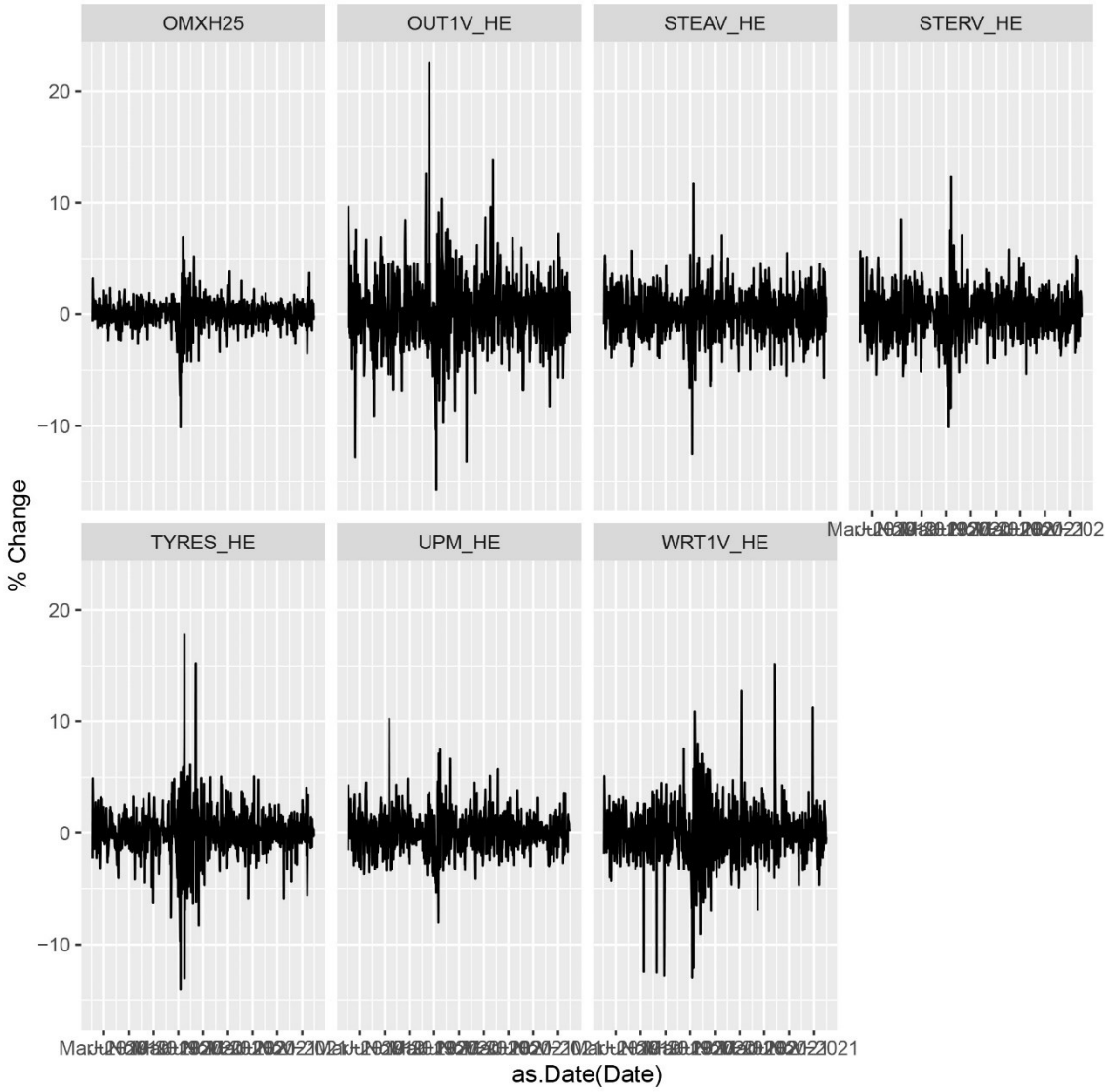

FSKRS_HE
KNEBV_HE
MOCORR_HE
NESTE_HE
MOKIA_HE
OMXH25
OUT1V_HE
STEAV_HE
STERM_HE
TYRES_HE
UPM_HE
WRTSI_HE

Appendix 3. Volatility plots

Volatility histogram set 1/2



Volatility histogram set 2/2



Appendix 4. Data Wrangling

Line plot

```
# Used libraries
library(tidyverse)
library(dplyr)
library("PerformanceAnalytics")
library("Hmisc")
library(ggrepel)
library(zoo)
library(ggplot2)
library(quantmod)
library(stringr)
library(tidyr)
library(dplyr)
library(knitr)

list.files <- list.files(path = "./")
special_word<-".csv"
temp = list.files(pattern=special_word)
myfiles = lapply(temp, read.delim, sep=",",header=TRUE)
names(myfiles)<-gsub(".csv","",temp)
setwd("./")
# Set Class to numeric
cols = c(2, 3, 4, 5,6, 7)
for(i in 1:length(myfiles)) {
  myfiles[[i]][,cols] = apply(myfiles[[i]][,cols], 2, function(x) as.numeric(as.character(x)))
}

# Bind all list elements to DF
df.myfiles<-bind_rows(myfiles, .id="Company")
# Set class to Date
df.myfiles$Date<-as.Date(df.myfiles$Date)

paivat<-as.Date(c("2019-12-31","2020-10-01","2020-01-24","2020-01-29","2020-02-11","2020-02-22","2020-03-12","2020-
03-15","2020-04-22","2020-05-06","2020-09-01","2020-12-26","2021-02-01","2021-02-17","2021-03-01","2021-06-17","202
1-06-15","2020-09-15","2021-11-22"))


# Line plot
a<-ggplot(data = df.myfiles, aes(x=Date, y=Adj.Close)) + geom_line(aes(colour=Company))
print(a)
```

Correlation matrixes

```
# Select only Adj.Close from all companies and build Matrix
# Bind all list elements to DF
# Join different compainies y Date to Matrix
testi<- myfiles %>% reduce(inner_join, by='Date')
## Select only Adj.Close columns
testi2<-testi[,grep("Adj.Close.", colnames(testi))]
## Set colnames
colnames(testi2)<-names(myfiles)
## Set rownames
rownames(testi2)<-testi$Date

# Correlation analysis
cat("## Whole Time period")
```

```
write.csv2(res2$P, "P-Value Matrix.csv")
write.csv2(res2$r, "Correlation Matrix.csv")

# Time period spesific tables
pre_pandemic<-testi2[rownames(testi2) >= "2019-01-01" & rownames(testi2) <= "2019-12-30", ]
incubation<-testi2[rownames(testi2) >= "2020-01-02" & rownames(testi2) <= "2020-01-17", ]
outbreak<-testi2[rownames(testi2) >= "2020-01-20" & rownames(testi2) <= "2020-02-21", ]
fever<-testi2[rownames(testi2) >= "2020-02-24" & rownames(testi2) <= "2020-03-20", ]
uncertainity<-testi2[rownames(testi2) >= "2020-03-21" & rownames(testi2) <= "2020-05-06", ]
adaption<-testi2[rownames(testi2) >= "2020-05-07" & rownames(testi2) <= "2020-12-23", ]
new_normal<-testi2[rownames(testi2) >= "2020-12-28" & rownames(testi2) <= "2021-12-30", ]


# Make list containing all of those
all.periods<-list(Pre_pandemic=pre_pandemic,Incubation=incubation, Outbreak=outbreak,Fever=fever ,Uncertainity=unce
rtainity,Adaption=adaption, New_normal=new_normal)

for(i in 1:length(all.periods)) {

  cat("## ", names(all.periods)[i])
  cat("\n")
  cat("\n")
  chart.Correlation(all.periods[[i]], histogram=TRUE, pch=10)
  pdf(paste0(names(all.periods)[i], " Correlation Matrix_LV_MT.pdf"))
  print(chart.Correlation(all.periods[[i]], histogram=TRUE, pch=10))
  dev.off()

  res2 <- rcorr(as.matrix(testi2))
  res2
  write.csv2(res2$P, paste0(names(all.periods)[i]," P-Value Matrix.csv"))
  write.csv2(res2$r, paste0(names(all.periods)[i]," Correlation Matrix.csv"))
  }
```

Volatility

```
# Volatility
testi2.date<-testi2
testi2.date$DATE<-rownames(testi2.date)

## Compute daily percent changes
for (col in names(testi2.date)[-ncol(testi2.date)]) {
  symbol <- str_sub(col, 1)
  new_col_name <- paste(symbol, "% Change")
  col_values <- testi2.date[[col]]
  testi2.date[[new_col_name]] <- 100*(col_values - lag(col_values))/lag(col_values)
}
# Remove first row
testi2.date <- testi2.date[-1, ]

# Data manipulation
testi3.date<-testi2.date[,grep("% Change", colnames(testi2.date))]
testi3.date$Date<-rownames(testi3.date)
colnames(testi3.date)<-gsub(" % Change","",colnames(testi3.date))
testi3.date_df <- gather(testi3.date, key = "Symbol", value = "% Change", 1:(ncol(testi3.date)-1))

# Plot data
ap<-ggplot(data = testi3.date_df) +
  geom_line(aes(x = as.Date(Date), y = `% Change`)) +
  facet_wrap("Symbol", nrow  = 2) +
  scale_x_date(date_labels = "%b")

print(ap)
```

Standard Deviation of % Change e.g.

```
# Compute the standard deviation of the percent changes
testi3.sd<-testi3.date_df %>%
  dplyr::group_by(Symbol) %>%
  summarise(`Standard Deviation of % Change` = sd(`% Change`)) %>%
  arrange(desc(`Standard Deviation of % Change`))

print(kable(testi3.sd))
```

```
##
##
## |Symbol    | Standard Deviation of % Change|
## |:---------|------------------------------:|
## |OUT1V_HE  |                       3.121959|
## |MOCORP_HE |                       2.966302|
## |NOKIA_HE  |                       2.562466|
## |WRT1V_HE  |                       2.517777|
## |NESTE_HE  |                       2.295878|
## |TYRES_HE  |                       2.224236|
## |STERV_HE  |                       2.102131|
## |STEAV_HE  |                       2.043285|
## |FSKRS_HE  |                       1.830186|
## |UPM_HE    |                       1.698161|
## |KNEBV_HE  |                       1.372109|
## |OMXH25    |                             NA|
```

P-value Matrix – Fever period e.g.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1		FSKRS_HE	KNEBV_HE	MOCORP_	NESTE_HE	NOKIA_HE	OMXH25	OUT1V_HE	STEAV_HE	STERV_HE	TYRES_HE	UPM_HE	WRT1V_HE
2	FSKRS_HE	NA	0	0	0	0	0	0	0	0	0	0	0
3	KNEBV_HE	0	NA	0	0	3,63E-12	0	0	0	0	0	0	0
4	MOCORP_	0	0	NA	0	2,24E-05	0	0	0	0	0	0	1,17E-07
5	NESTE_HE	0	0	0	NA	0,288226	0	0	0	0	0	0	0,258384
6	NOKIA_HE	0	3,63E-12	2,24E-05	0,288226	NA	0	0	1,75E-06	0,000506	0	1,57E-06	0
7	OMXH25	0	0	0	0	0	NA	0	0	0	0	0	0
8	OUT1V_HE	0	0	0	0	0	0	NA	0	0	0	0	0
9	STEAV_HE	0	0	0	0	1,75E-06	0	0	NA	0	0	0	1,03E-11
10	STERV_HE	0	0	0	0	0,000506	0	0	0	NA	0	0	4,81E-06
11	TYRES_HE	0	0	0	0	0	0	0	0	0	NA	0	0
12	UPM_HE	0	0	0	0	1,57E-06	0	0	0	0	0	NA	1,10E-12
13	WRT1V_H	0	0	1,17E-07	0,258384	0	0	0	1,03E-11	4,81E-06	0	1,10E-12	NA

Adaption Correlation Matrix data e.g.

	FSKRS_HE	KNEBV_HE	MOCORP_	NESTE_HE	NOKIA_HE	OMXH25	OUT1V_HE	STEAV_HE	STERV_HE	TYRES_HE	UPM_HE	WRT1V_HE
FSKRS_HE	1	0,408728	0,810242	0,649606	0,558943	0,927529	0,904247	0,830864	0,789277	0,899307	0,803092	0,568817
KNEBV_HE	0,408728	1	0,752551	0,841277	-0,25018	0,604134	0,337964	0,714748	0,761931	0,362129	0,628227	-0,34544
MOCORP_	0,810242	0,752551	1	0,866623	0,154149	0,916408	0,793027	0,959798	0,940475	0,81564	0,91023	0,191997
NESTE_HE	0,649606	0,841277	0,866623	1	-0,03883	0,785422	0,58532	0,855911	0,900398	0,661108	0,760975	-0,04132
NOKIA_HE	0,558943	-0,25018	0,154149	-0,03883	1	0,435765	0,519378	0,173533	0,12669	0,523122	0,174294	0,809299
OMXH25	0,927529	0,604134	0,916408	0,785422	0,435765	1	0,90867	0,918092	0,908851	0,894906	0,917333	0,442001
OUT1V_HE	0,904247	0,337964	0,793027	0,58532	0,519378	0,90867	1	0,829677	0,781554	0,855692	0,851232	0,589444
STEAV_HE	0,830864	0,714748	0,959798	0,855911	0,173533	0,918092	0,829677	1	0,964661	0,828034	0,917656	0,244975
STERV_HE	0,789277	0,761931	0,940475	0,900398	0,12669	0,908851	0,781554	0,964661	1	0,797151	0,922252	0,166093
TYRES_HE	0,899307	0,362129	0,81564	0,661108	0,523122	0,894906	0,855692	0,828034	0,797151	1	0,77839	0,6495
UPM_HE	0,803092	0,628227	0,91023	0,760975	0,174294	0,917333	0,851232	0,917656	0,922252	0,77839	1	0,255982
WRT1V_H	0,568817	-0,34544	0,191997	-0,04132	0,809299	0,442001	0,589444	0,244975	0,166093	0,6495	0,255982	1

Raw data, Nokia, e.g.

Date	Open	High	Low	Close	Adj Close	Volume
2019-01-02	5.030000	5.040000	4.942000	5.006000	4.702405	14783198
2019-01-03	4.977000	5.006000	4.874000	4.908000	4.610349	13913719
2019-01-04	4.918000	5.120000	4.918000	5.102000	4.792584	17736514
2019-01-07	5.200000	5.212000	5.134000	5.212000	4.895912	16597787
2019-01-08	5.218000	5.324000	5.206000	5.260000	4.941002	20491208
2019-01-09	5.350000	5.368000	5.304000	5.328000	5.004878	18171418
2019-01-10	5.316000	5.320000	5.234000	5.294000	4.972939	14051523
2019-01-11	5.320000	5.320000	5.202000	5.270000	4.950395	13346675
2019-01-14	5.222000	5.288000	5.206000	5.238000	4.920335	13033316
2019-01-15	5.250000	5.304000	5.192000	5.250000	4.931607	11960487
2019-01-16	5.268000	5.280000	5.172000	5.172000	4.858337	18479206
2019-01-17	5.190000	5.242000	5.174000	5.216000	4.899670	13644721
2019-01-18	5.246000	5.346000	5.238000	5.304000	4.982332	23109513
2019-01-21	5.350000	5.368000	5.300000	5.344000	5.019907	7298914
2019-01-22	5.318000	5.334000	5.236000	5.264000	4.944758	14047754
2019-01-23	5.222000	5.362000	5.204000	5.314000	4.991727	14887661
2019-01-24	5.332000	5.442000	5.308000	5.430000	5.100691	17460725
2019-01-25	5.500000	5.742000	5.486000	5.742000	5.393770	35886031
2019-01-28	5.740000	5.740000	5.598000	5.626000	5.284804	27418083
2019-01-29	5.620000	5.704000	5.592000	5.700000	5.354317	20115948
2019-01-30	5.716000	5.734000	5.592000	5.682000	5.337409	22634211
2019-01-31	5.342000	5.600000	5.266000	5.508000	5.173961	62727794
2019-02-01	5.484000	5.500000	5.352000	5.400000	5.072511	25270117
2019-02-04	5.360000	5.390000	5.226000	5.268000	4.948516	19129849