Handelshøyskolen BI

GRA 19703 Master Thesis

Thesis Master of Science 100% - W

Predefinert informasjon

Startdato:	16-01-2022 09:00	**Termin:**	202210
Sluttdato:	01-07-2022 12:00	**Vurderingsform:**	Norsk 6-trinns skala (A-F)
Eksamensform:	T		
Flowkode:	202210||10936||IN00||W||T		
Intern sensor:	(Anonymisert)		

Deltaker

Eivind Aronsveen, Charlotte Skjæveland

Informasjon fra deltaker

Tittel *:	IPOs issued during the COVID-19 pandemic in Norway and Sweden
Navn på veileder *:	Siv Staubo

Inneholder besvarelsen konfidensielt materiale?:	Nei	**Kan besvarelsen offentliggjøres?:**	Ja

Gruppe

Gruppenavn:	(Anonymisert)
Gruppenummer:	304
Andre medlemmer i gruppen:	

IPOs issued during the COVID-19 pandemic in Norway and Sweden

An empirical study of how COVID-19 affected IPOs in Norway and Sweden
- utilizing underpricing and volatility as proxies for induced information uncertainty caused by the pandemic.

Charlotte Skjæveland & Eivind Aronsveen

Supervisor: Siv Staubo

MSc in Business major in Finance

BI Norwegian Business School

Abstract

This thesis investigates the COVID-19-induced information uncertainty and its effect on IPOs in Norway and Sweden—utilizing underpricing and post IPO stock return volatility as proxies for information uncertainty. We do a comprehensive analysis investigating the dynamics of IPOs issued from 2018 until 2021 to capture the effect of the COVID-19 pandemic. Per previous research on other financial markets, we found that the COVID-19 pandemic adversely impacted the IPO market. The IPO information uncertainty increased following the pandemic intensity and government responses. IPOs listed during the COVID-19 pandemic experienced 7% greater underpricing and a 1.5% increase in post IPO stock volatility, fluctuating in tandem with the respective countries' macroeconomic trends.

Acknowledgments

Associate professor, Siv Staubo, deserves special thanks for offering competent academic guidance and valuable input while writing our master thesis. Her knowledge and encouragement were of utmost appreciation.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

1.0 Introduction

The COVID-19 pandemic was declared a pandemic by the World Health Organization in March 2020; following, economies and financial markets entered a global recession characterized by immense uncertainty. This research paper focuses on IPO activity and the increase in information uncertainty due to the COVID-19 pandemic, using underpricing and post-IPO stock return volatility as proxies. Previous research on equity, debt, and derivative markets proves that the severity of the outbreak and government policy measures led to increased volatility and uncertainty (Zarema et al., 2021; Baig et al., 2021; Johnand Li, 2021). Thus, it resulted in a consensus that the pandemic induced uncertainty, and the government initiatives that preceded it have negatively impacted the quality and effectiveness of markets and institutions. Following the market observations and IPO theories, we expect higher underpricing and volatility for IPOs issued during the pandemic. However, it is expected to have an adverse effect as increased uncertainty positively correlates with IPO underpricing, and it is natural to assume greater underpricing in periods of distress (Beatty & Ritter, 1986). Moreover, we expect a rise in post-IPO stock return volatility following the declining market (i.e., the Swedish and Norwegian GDP decreased by 3.25% in 2020), indicating higher financial risk concerning IPOs issued post-COVID-19 (Esterling, 2022).

In the pandemic years (2020-2021), the need for capital increased rapidly as the pandemic constrained investment and capital injections for companies, leading to more companies going public. As a result, we experienced a boom in the Nordic IPO market with an increase of 110% in the first pandemic year, with Norway and Sweden as the leading countries in Europe (Wass & Ahmad, 2021). The pandemic forced governments to adapt and act quickly to secure their countries' health and economy. There were significant differences in how countries dealt with the crisis, resulting in various outcomes. Hence, our thesis examines Norway and Sweden jointly and separately to find the fundamental forces behind the IPO changes, as it is evident that informational shocks and government responses concerning the pandemic have affected the IPO markets.

The analysis is based on IPOs issued in the Norwegian and Swedish markets from 2018 until 2021 to compare underpricing in pandemic and non-pandemic years. We find that IPOs issued after March 2020 are, on average, 7% more underpriced than those issued before the COVID-19 pandemic. Furthermore, the post-pandemic IPOs had an average stock return volatility of 4.62%. It is evident that the pandemic has led to increased information uncertainty, and we observe significant fluctuations in initial returns. The analysis indicates that the IPO market learned to tackle the information uncertainty throughout 2020 and 2021, though stabilizing at a higher level after the initial shock of the pandemic. Therefore, we wish to examine how the increased information uncertainty correlates with the pandemic intensity.

We were motivated by the economic significance of IPOs and their correlation to the macroeconomic trend in financial markets, giving us a broader understanding of the mechanisms behind information uncertainty due to the COVID-19 pandemic. This thesis extends current literature (i.e., Mazumder & Saha, 2021; Zaremba et al., 2020; A. S. Baig & Chen, 2022) and bridges a gap between IPO literature and the COVID-19 pandemic in Norway and Sweden. The thesis suggests that following the increase in pandemic intensity, we see a positive correlation with the underpricing and volatility of Norwegian and Swedish IPOs.

2.0 Theoretical and empirical framework

The need for capital has increased rapidly as the pandemic[1] has constrained investment and capital injections for companies, leading to more companies going public. As other financial aspects of the economy were highly affected by increased information uncertainty, we expect this to impact the IPO activity during the pandemic. We have seen that increased uncertainty positively correlates with IPO underpricing (Beatty & Ritter, 1986), and it is natural to assume greater underpricing and volatility in periods characterized by higher IPO activity. In the following section, we will focus on how the corona pandemic has created economic uncertainty and how this further affects the underpricing and volatility of IPOs in Norway and Sweden. This section will present a theoretical framework for why companies decide to go public, IPO pricing, and the underpricing phenomenon.

2.2 Covid-19 pandemic

We entered a time with significant economic downturns, uncertainty, and the need for fundamental changes. To preserve people's health and economy, governments devised several measures to combat the situation. The World Health Organization declared the Covid-19 outbreak a pandemic on March 11th, 2020, barely a month after they proclaimed it a Public Health Emergency of International Concern (World Health Organization, 2022). Contentions in how countries dealt with the crisis were evident, resulting in several differences and outcomes. To this extent, we will see how the governmental differences and similarities in Norway and Sweden impacted IPO activity, underpricing, and volatility.

Several research papers have focused on different financial markets and the impact of the COVID-19 pandemic. Research from Zaremba et al. (2020) and Baig et al. (2021) proved that the outbreak's severity and government policy measures lead to increased volatility and uncertainty in the equity markets. As a result, there appears to be widespread agreement that pandemic-induced uncertainty and the government initiatives that preceded it negatively impacted the quality and effectiveness of markets and institutions. However, analysis of IPOs during the pandemic remains largely unexplored. Research from Mazumder and Saha (2021) investigates the relationship between fear related to COVID-19 and the short-term performance of

[1] Pandemic in this thesis refers to the COVID-19 pandemic

IPOs. Utilizing an equally weighted index consisting of daily cases and deaths in the U.S., the study evaluates whether the fear of the pandemic impacts initial returns. The study is motivated by the fact that IPOs initial returns in 2020 were almost 9.30% higher than in the last 40 years.

Interestingly, results show that initial returns are negatively correlated with fear of the COVID-19 pandemic, contradicting the results from Baig and Chen (2022), which found a positive association between underpricing, stock return volatility, and the intensity of the COVID-19 pandemic. Further, they analyzed information uncertainty caused by the pandemic and its effect on the IPO market. They wanted to see if the pandemic adversely impacted IPOs, as the general perception is that the IPO market was less affected than other financial markets. Previous research focuses on the U.S. market; therefore, we will investigate if the Nordic market, specifically Norway and Sweden, experienced similar market dynamics. We choose these countries as they have similar prerequisites. However, they implemented different tactics and governmental responses to tackle the crisis. Following, we will see how the government responses affected the economic aspects of the respective countries, focusing on IPO activity, underpricing, and volatility.

2.2.1 Economical impact

This section provides corona- and country-specific economic statistics to understand the significant impact of the pandemic in Norway and Sweden. The first pandemic case in Sweden was discovered on January 24th 2020, and barely a month later, the first case was documented in Norway on February 26th (Rolander & Wilen, 2020; Treloar, 2020). Until the first quarter of 2021, Sweden was the European country with the highest infection rate at approximately 8%, whereas Norway had the lowest rate at 1.77%.[2] The difference in new cases can be seen in the graph below (*Figure 1*), illustrating the number of new cases per million citizens in Norway and Sweden. (Ritchie, 2020).

[2] All COVID-19-related data is retrieved from: https://ourworldindata.org/coronavirus

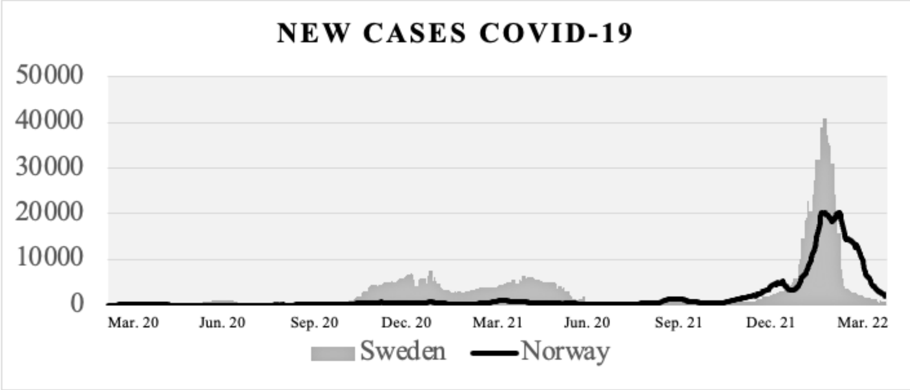

Figure 1: New cases of COVID-19. *The graph illustrates the number of COVID-19 cases calculated over a seven-day average (represented on the y-axis) in Norway and Sweden from the 26th of February until the 1st of March 2022 (represented on the x-axis).*[2] *Until the first quarter of 2021, Sweden was the European country with the highest infection rate at approximately 8%, whereas Norway had the lowest rate at 1.77%.*

Following the outbreak of the pandemic, the World Economy decreased by 4.3% in 2020 (The World Bank, 2022). At the same time, Norway experienced an annual drop of 1.4% due to the pandemic; however, it remained one of the countries with the highest GDP per capita in the world (Statista, 2022b). Both Norway and Sweden were some of the European countries that were less severely hit by the pandemic in terms of GDP. However, Sweden had over 3% more gross domestic product decline than Norway in 2020 (Statista, 2022a). The initial shock of the pandemic was severe as Norway and Sweden experienced a drop in GDP growth of 7.1% and 7.4% relative to the same period in 2019 (The World Bank, 2022). Moreover, it is evident that the Swedish economy is more sensitive to the crisis with increased market fluctuations; however, they tend to recover quickly with a sharp percentage increase from a recession. This is apparent by a total accumulation of 8.6% change the year after the outbreak, whereas Norway is more stable with an increase of 4.7% in 2021 compared to 2020.

The countries and their economies responded similarly during the COVID-19 pandemic following the increase in pandemic intensity. To better understand the severity of the crisis, we will compare the GDP-growth changes to what happened during the financial crisis of 2008. As mentioned, both Sweden and Norway managed the economic situation of the pandemic well; however, the Norwegian GDP volatility increased by 1% more during the pandemic than during the financial crisis of 2008. At the same time, Sweden experienced 0.9% higher volatility in the financial crisis than during the pandemic. Thus, one might argue that the financial crisis of 2008 impacted Sweden more than the COVID-19 pandemic, observing the contradictory impact in Norway.

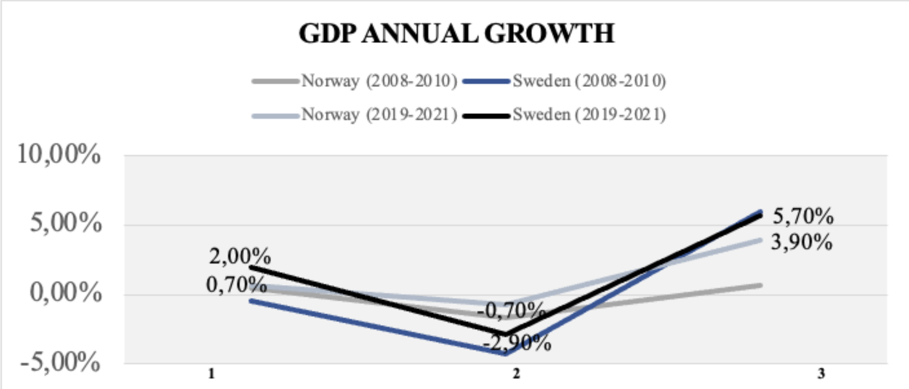

Figure 2: GDP annual growth. *The figure illustrates annual growth changes in the Gross domestic product (GDP) (% change is represented on the y-axis) in Norway and Sweden from 2008-2010 and 2019-2021 (represented as three periods on the x-axis). The Norwegian GDP volatility increased by 1% more during the pandemic compared to the financial crisis of 2008. At the same time, Sweden decreased the volatility by 0.9% more compared to the financial crisis.*

Further, we recognize the changes in the unemployment rate in both countries, giving us a better picture of the economic situation. In the first pandemic year, the unemployment rate in Norway increased by approximately 1%, while Sweden had an increase of 2% (Macrotrends, 2022). Hence, the countries were forced to issue substantial economic support to households in order to assure the future economy and employment rate. Both countries spent approximately 4% of the GDP on emergency and recovery packages, whereas 50% of the economic support went to the financial sector (Hovland, 2021).

2.2.2 Governmental responses

The Swedish and Norwegian governments implemented several restrictions, and the respective Central Banks devised measures to preserve a stable economy per the country's objectives. Previous research from Cieslak & Schrimpf (2019) found that the signals conveyed by Central Banks significantly impact markets. In response to the pandemic, the two countries lowered their policy rates to ensure economic value, securing a stable and efficient financial system. The Central Banks' objectives are similar in both countries, where the essential factor to securing the economy is keeping the inflation low and stable, being the base of the devised government restrictions (Norges Bank, n.d.; Sveriges Riksbank, n.d.). Norway and Sweden implemented various measures in response to the COVID-19 outbreak to preserve people's health and economy. In addition to the economic aid, the countries had to close schools and workplaces, as well as travel restrictions to slow the spreading of the virus. To capture the measures implemented by Norway and Sweden in response to the COVID-19 outbreak, we apply the Oxford Covid-19 Government Response Tracker (OxCGRT), referred to as the Stringency index. The index helps us systematically and consistently compare policy responses throughout the pandemic (Roser, 2021).

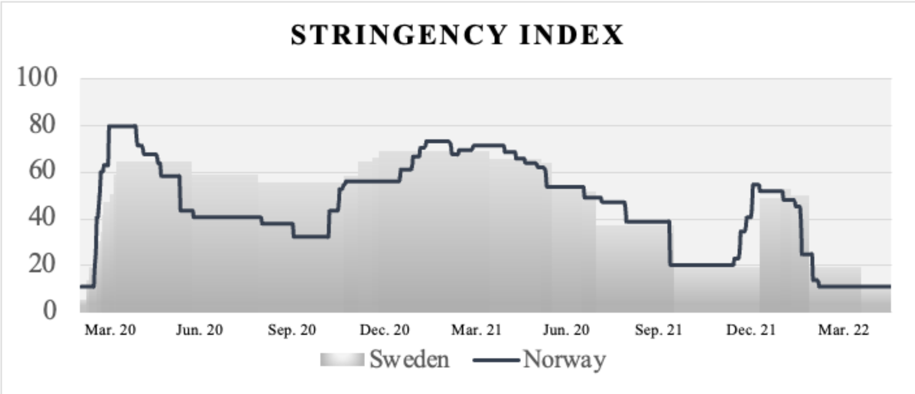

Figure 3: Stringency index. *The graph illustrates the strictness level (level of government responses) in Norway and Sweden from value 0-100 (represented on the x-axis) from 1st of March 2020 until 1st of March 2022 (represented on the y-axis). The index measure is based on nine response indicators, including school closure, workplace closure, and travel restrictions.*

Research from Adra (2021) discovered that monetary policy is essential in shaping the IPO market. A monetary shock that raises the cost of debt while conveying positive economic information may encourage more private companies to go public. As a result, companies benefit from higher stock market values and can use their IPO profits toward scaling their business. The article demonstrates how monetary policy shapes the dynamics of the IPO market significantly and independently. Conclusively, it reveals that the informational impact of monetary shocks has the same effect on IPO activity as the conventional impact. Hence, we would like to see if there is a correlation between the government responses and the increase in information uncertainty and assess the government responses in Norway and Sweden during the COVID-19 pandemic.

Furthermore, we will use government responses and the countries' reactions to the pandemic to research its effect on our two proxies for information uncertainty. Even though the Stringency Index only indicates a slight variation between Norway and Sweden, we must recognize the observed distinctions. The countries tackled the pandemic differently regarding responsibility strategy, capacity, and legitimacy. While Sweden primarily opted for voluntary measures and provided guidelines, with the perception that the pandemic would not be of such significance, "downplaying" the severity compared to Norway, which quickly implemented severe and intrusive measures.

2.3 Fundamentals of Initial Public Offerings

To appropriately evaluate and assess our research question, we must thoroughly grasp the dynamics surrounding an IPO. In the following section, we describe the core IPO theories, principles, and procedures underlying initial public offerings.

2.3.1 Going Public

A corporation may go public for various reasons, but the primary one is to raise capital to expand its business and stimulate growth. Going public can undoubtedly be deemed one of the most exciting events in the lifespan of a company. An initial public offering, often referred to as a stock launch, involves offering the company's shares to the public for the first time, often consisting of a combination of institutional- and private investors. The company is then listed on one or more stock exchanges and traded on the open market. The shares offered to the public are either primary shares, which are newly issued shares of common stock, or preexisting shares, which are shares held by existing shareholders. Alternatively, the offering could be a combination of primary and preexisting shares. In either case, the IPO will alter the firm's ownership structure by diluting existing shareholders or selling existing shares to new investors. The price at which shares are offered is either settled by a book-building process or as a fixed price. A company's initial public offering is complex, time-consuming, and may, in some cases, commence for several years before its shares are traded in the secondary market. In the process of an IPO, there are primarily three actors involved: the issuer, the underwriter, and the investor.

The issuer

The company going public is referred to as the issuer. Apart from making the initial decision to go public, the issuer needs to dispense shares to be sold in the offering and employ a suitable underwriter to work as an intermediary between investors and the company itself. From the issuer's standpoint, the principal objective of the IPO is to obtain the highest feasible offer price for its shares in order to augment high proceedings from the offer. The company will use the funds to promote future expansion and become more established; therefore, raising fresh capital is one of the most significant factors for the issuer in the offering. However, the goal of raising the highest possible proceedings is counterbalanced by the necessity to keep investors pleased with their investment, preserve investor relations, and ensure the actual success of the IPO itself. On the other hand, if the offer price is set below the true market price, the issuer will not be able to fulfill its full potential for acquiring capital. The latter occurrence is referred to as "leaving money on the table" in the IPO underpricing literature (Loughran & Ritter, 2002).

Underwriter:

Underwriters in an IPO are usually commercial or investment banks that assist the issuing company through the IPO process. The company performing the IPO typically enlists one or multiple underwriters. The underwriter and issuing company work together to determine, among other things, legal- and financial requirements and the respective offering method. In essence, the underwriter provides financial guidance to the company in terms of documentation and requirements for the IPO, while working as an intermediary between the company and potential investors, seeking to satisfy both clientele. For the issuing company, choosing an underwriter is of utmost importance, as a prestigious underwriter provides confidence to investors, positive market signals, and lower risk offerings (Carter & Manaster, 1990). The primary function of the underwriter is to purchase shares from the issuing firm and resell them to investors. Consequently, the underwriters make their profit from the difference (spread) between these two transactions.

Chen and Ritter (2000) investigated 1111 IPOs in the U.S. during the period 1995-1998 and found this spread to be 7% of total proceeds, independent of the size of the IPO. Thus, the margins of the underwriter are more attractive when the issuing company is relatively big. Furthermore, the underwriter has an incentive to underprice the shares to ensure investor demand, ease marketing processes, and overall enhance the probability of selling all the shares they acquired from the issuing company. However, to ensure future business opportunities, the underwriters need to price the shares fairly to assure their reputation and relationship with issuing companies and investors.

Investor:

When referring to the investor in an IPO, it is essential to distinguish between institutional and private investors. Institutional investors are usually hedge funds, mutual funds, pension funds, or banks, while private investors are referred to as retail investors. Institutional investors benefit from the ability to aggregate significant sums of money to invest on a large scale. Compared to regular investors, they have more expertise and resources, resulting in informational advantages in terms of valuation and financial understanding (Hanley & Wilhelm, 1995). Moreover, institutional investors typically have some sort of relationship with the banks that function as underwriters, resulting in a higher probability of getting assigned shares in popular IPOs. Both types of investors have the same goal, getting as many shares as possible of the attractive IPO while avoiding pricey ones. Attractive IPOs are usually oversubscribed, where investors compete for the same shares, making it difficult to obtain the desired amount. Hence, institutional investors may have crucial advantages by having solid relationships with underwriters, as they eventually allocate the respective shares.

2.3.2 The process of going public

As mentioned earlier, an IPO is a time-consuming process, depending on a variety of factors. Jenkinson and Ljungqvist (2001) divide this process into a timeline consisting of five stages: Market selection, choice of underwriter, prospectus design, information gathering, and share allocation:

(1) The first step of this process involves identifying a market in which the issuing company wants to go public. This is typically a decision based on the respective stock exchange's liquidity, listing requirements, industry relevance, and institutional environment of the host market (Moore et al., 2012). The stock exchanges they desire to list on may be domestic and foreign, where smaller exchanges may have less stringent listing criteria than bigger ones with more liquidity.

(2) The next step is for the issuing company to hire an investment bank to serve the role of an underwriter. Normally, for larger IPOs, a syndicate of multiple underwriters is common practice. Together with the company, the lead underwriter defines the role of each actor in the IPO, together with the offering mechanism, among other details.

(3) Following the choice of hiring one or more underwriters, the prospectus needs to be designed. This document should include all necessary information for an investor to make an educated investment decision. E.g., it should include risk considerations, industry facts, financials, management descriptions, capitalization, and intended use of the proceeds. Not only is such a prospectus required by exchanges to be listed, but it also works as an advertisement to attract investors.

(4) In the fourth step, the underwriter must gather information about investor interest and demand to accurately set the respective offer price. This stage of the process is crucial, as the offer price must reconcile with investor demand and expectations of the issuing company. In order to accurately decide this offer price, underwriters collect non-binding bids from investors. This method is referred to as "book-building" and is the most frequently used method for Scandinavian IPOs. Another pricing strategy is using a predetermined or fixed price for the issued shares. By utilizing this method, investors are informed about the price prior to the offering; however, underwriters have little to no information about the market demand.

(5) After establishing the offer price, the final step in the process entails allocating shares to subscribed investors. If the demand from inventors exceeds the supply of shares, the IPO is said to be oversubscribed and, consequently, undersubscribed if the demand is too low. In the case of an oversubscribed IPO, the underwriter uses information from the book-building period, where investors with the highest non-binding bids usually get the majority of shares allocated. A lottery is another option for allocating shares to investors in the case of oversubscription. However, institutional investors are often allotted the majority of available shares, which are hand-picked by the underwriter, further enhancing the importance of solid relationships. An over-allotment option is another technique to deal with oversubscription. The underwriter agreement normally includes this option, allowing the underwriter to sell more shares than the issuer initially intended in the case of oversubscription.

The issuer is ready to go public on the listing date once the company and its underwriters have completed all five stages above. The shares are usually purchased on the secondary market by investors who did not obtain shares throughout the offering process. Because underpricing occurs regularly, some investors may take advantage and sell on the first day of trading, a practice known as "flipping" (Aggarwal, 2001).

2.4 Underpricing

Following the initial public offering and consequent listing of the company on the public market, the underpricing phenomenon tends to occur. Underpricing is when the subscription price is set at a discount relative to the share's realized market price after it starts trading in the secondary market. The initial return, which measures the return from the subscription price to the closing price on the first day of trading, is the most frequent method of measuring underpricing. The phenomenon can be seen as an indirect cost to the company or shareholder selling shares in the IPO, as they are "leaving money on the table ", in other words, selling their shares below their true market value. In a study conducted in the U.S. from 1990 to 1998, Loughran and Ritter (2002) estimated this indirect cost of corporations going public to be a staggering $27 billion.

Since Reilly and Hatfield (1969) published the first documented incidence of new issues underpricing, the phenomenon has gained substantial attention from scholars and enthusiasts worldwide and is perhaps the most investigated topic in the IPO literature. The phenomenon piqued academic interest because it directly contradicts the efficient market hypothesis and theories about investor rationality. Additionally, it raises the question of why companies repeatedly wish to sell their shares at significantly lower prices than the market appears to value them.

A common argument in the current IPO literature is that issuers need to "leave money on the table" to attract investors (Bergström et al., 2006). Further, Loughran and Ritter (2002) argue that issuers are prepared to forego huge sums of money in return for important analyst coverage, which is received from top-tier investment banks. They further contend that the owners of underpriced issues do not get troubled, as they realize they are more prosperous than they initially believed. According to Rock (1986), underpricing of IPOs is a way of rewarding uninformed investors for their lack of knowledge regarding the company's genuine value compared to informed investors. In the absence of underpricing, investors would prefer to acquire the shares in the secondary market after a clear distinction has been reflected between attractive and unattractive companies. Thus, positive short-term returns may be considered compensation for taking additional risk (Jenkinson & Ljungqvist, 2001)

2.4.1 Empirical evidence of underpricing

As earlier noted, Reilly and Hatfield (1969) documented the first actual evidence of IPO underpricing by analyzing 53 American issues from 1963 to 1966 and found an average initial return of 9.9%. Researchers have since shown continuous underpricing of IPOs and positive first-day returns for investors. Loughran et al. (1994) compiled results from multiple earlier studies and observed that initial first-day returns vary considerably over time and among nations. In the original study, 25 countries were included, and short-run underpricing was shown to vary extensively, from 4.2% in France to 80.3 % in Malaysia. Jay Ritter has since updated and revised these results regularly through his website containing extensive IPO data from all over the world. Ritter reveals an average first-day return of 17.7% from a sample of 13,826 IPOs in the U.S. during the time-period 1960-2022, providing, on average, large returns to investors participating in IPOs (Ritter, 2022).

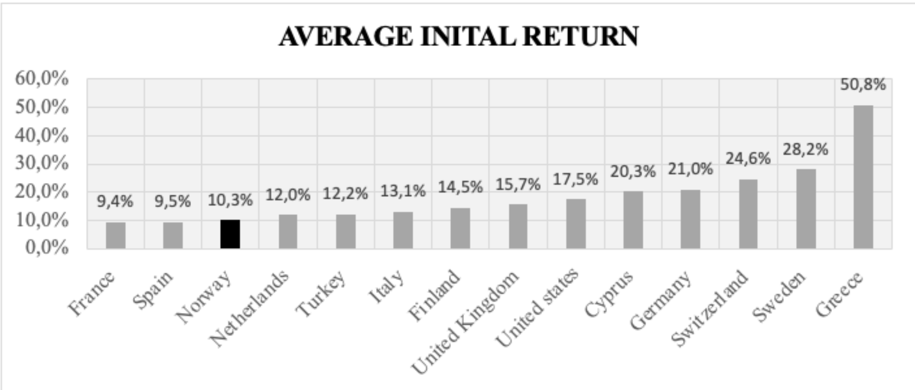

Figure 4: Average Initial Return worldwide. *The figure illustrates the average initial return (represented on the y-axis) in the U.S. and a selection of European Countries (represented on the x-axis) from 1960 until 2022. All numbers are retrieved from Jay Ritter's website.* (Ritter, 2022)

2.4.2 IPO market cycles

In the Underpricing literature, we also find evidence that IPO activity seems to fluctuate over time, both in terms of IPO volume, first-day initial returns, and total proceeds (He, 2007). Ibbotson and Jaffe (1975) were the first to document these cyclical patterns, defining periods consisting of high IPO activity and substantial first-day returns as "hot issue markets", and periods of low IPO activity and small first-day returns as "cold issue markets". Supporting these results, Ritter (1984) reveals an average underpricing of 16% from 1977-1982, whereas IPOs between January 1980 to March 1981 show an average underpricing of 48%. These Cyclical patterns have also been documented during the dot-com bubble, where average first-day returns were 65% from 1999-2000 and only 12% from 2001-2003 (Loughran & Ritter, 2004).

In a study by Ljungqvist et al. (2006), they found evidence that "hot issue markets" are characterized by high investor sentiment and that investors' impulsive behavior bolsters these market conditions. Lowry (2003) finds similar results, employing a 37-year time series of U.S. IPO volume, investigating whether efficient- versus inefficient-market factors can explain the fluctuations observed. The study explores three possible explanations: the aggregate capital demands of private firms, the asymmetric information implications of issuing securities, and investor optimism. Results show that investor sentiment and the company's demand for capital have significant explanatory power on the fluctuations in IPO volume. Moreover, that firms are more likely to have an IPO when they experience low adverse-selection costs of issuing equity (Lowry, 2003).

2.4.2 Main driving forces behind Underpricing

Ljungqvist (2007) reviews theoretical and empirical literature related to the underpricing phenomenon. In the paper, Ljungqvist (2007) classifies underpricing theories into four categories: asymmetric information, institutional explanations, control theories, and behavioral explanations. Following, we will present the asymmetric information and behavioral explanations theories, as we deem these most relevant for explaining variations in information uncertainty.

Asymmetric information

The existing literature regarding asymmetric information theories is extensive and regarded as the most studied theories of short-run underpricing. According to Ljungqvist (2007), theories of asymmetric information are the most established of the four aforementioned theories, where information frictions and conflicts of interest between the parties involved in the IPO have a first-order influence on underpricing. In short, asymmetric information theories assume that either the issuing company, the underwriter, or the investor holds superior information, resulting in information asymmetries.

Winner 's Curse

The winners curse model was initially presented by Rock (1986) and is perhaps the most prominent model for explaining asymmetric information. The model is an extension of Akerlof's (1970) lemons problem, with the assumption that certain investors hold superior information about the actual underlying value of the shares on offer compared to investors in general, the issuing firm or the underwriter. Further, informed investors only bid on IPOs deemed to be attractively priced, whereas uninformed investors bid indiscriminately (Rock, 1986). This results in the winner's curse for uninformed investors, being allocated all shares for which they bid in unattractive offerings—contradicting, only receiving a portion of their bid in attractive offerings, due to the participation of informed investors, leading to rationing of shares. The model further assumes that the two groups of investors do not have sufficient demand to fill the entire share allocation alone. Furthermore, uninformed investors are unwilling to participate in the IPO unless the conditional expected return is positive, allowing them to break even. Consequently, Rock (1986) argues that underwriters repeatedly underprice IPOs to attract uninformed investors.

An important implication of the model that has gained profound empirical support is a study from Beatty and Ritter (1986), which states that underpricing should rise with ex-ante uncertainty regarding the IPO firm's valuation. They provide the intuition that an investor who produces information indirectly buys a call option on the IPO, which is exercised if the 'true' price surpasses the respective offer price of the shares. The option's value consequently rises because of valuation uncertainty. The result is that more investors stive to be informed as valuation uncertainty increases. This, in turn, increases underpricing as more informed investors exacerbate the winner's curse problem. Frequently used proxies for valuation uncertainty found in the IPO literature evolves around company characteristics such as age (Megginson & Weiss, 1991) and market capitalization (Ritter, 1984), offering features as proceeds (Beatty & Ritter, 1986), prospectus disclosure as risk factors (Beatty & Welch, 1996), and aftermarket factors as trading volume (Miller & Reilly, 1987), and post-IPO stock return volatility (Ritter, 1984).

Signaling theory

Another well-established group of asymmetric information models that explains the degree of underpricing are the signaling theories. In essence, these theories assume that the issuer has the information advantage about a company's future expectations and is consequently better equipped to determine if the offer price is per the true value of the issue. Hence, companies may underprice the issue to send favorable market signals about the quality of the issuing firm (Welch, 1989).

Ibbotson and Jaffe (1975) are recognized for having the initial intuition of signaling in the IPO literature. They argue that issuing firms underprice their shares to "leave a good taste in investor's mouths." Although the strategy is costly, high-quality companies can recoup their losses in the future by having follow-on offerings on more favorable terms. Controversy, low-quality firms cannot afford to imitate the costly signal of high-quality firms because of the risk of not being reimbursed in subsequent offerings due to the positive probability that investors might be able to differentiate the two types of firms. Thus, the perception is that signaling can serve as an indicator of business quality (Allen & Faulhaber, 1989).

Behavioral Explanations

Several researchers question whether information frictions, institutional explanations, or control theories have a strong enough foundation to justify the underpricing phenomena. Thus, arguing that one should look to behavioral explanations. These theories explain underpricing as a result of either irrational investors who bid the price of the shares above their true value, or behavioral biases among issuers, where they do not put enough pressure on underwriters.

Informational cascades

First introduced by Welch (1992), the theory illustrates that informational cascades can arise between investors in some IPOs if they make their investment decisions sequentially. In short, investors will seek to assess the interest of other investors and further condition their offers on bids made by earlier investors, disregarding their own information. In the case of successful initial sales, subsequent investors might deem this as proof that earlier investors held beneficial information, further encouraging them to participate and neglect their own information. On the other hand, later investors might restrain themselves from making bids in the case of disappointing initial sales, even if they hold favorable information. As a result of possible cascades, early investors might demand additional underpricing in exchange for subscribing to the IPO, creating a positive cascade and snowball effect (Ljungqvist, 2007).

Investor sentiment

First presented by Ljungqvist et al. (2006), they constructed a model of how IPO companies respond to the existence of sentiment investors. The model implies that certain investors have overoptimistic beliefs about the IPO company. On the other hand, the issuer's goal is to capture as much of this surplus as possible. In doing so, firms going public need to find a balance in which they maximize the excess valuation without flooding the market. Thus, the optimal strategy is to hold back stocks to keep the price from decreasing, as excess stock supply will lead to depreciation. Over time, the stock's true value is revealed, and the price will return to its intrinsic fundamental value, meaning that the long-run performance returns will be negative. The theory, however, has some fundamental challenges, where it assumes constraints of short sales for arbitrageurs not to trade in a way that reviles the stock's fundamental value. Moreover, regulatory constraints on inventory holding and price discrimination make this strategy hard to implement for issuers. Instead, issuers might utilize a strategy where institutional investors are allocated stock before gradually selling of to retail investors. However, these institutional investors are exposed to a great extent of risk by participating and holding IPO stock, as the dynamics of these "hot" markets are hard to predict and might end prematurely.

Prospect theory and mental accounting

By utilizing Kahneman and Tversky's (1979) prospect theory, Loughran and Ritter (2002) argue that behavioral biases among managers of firms going public might explain why issuing firms do not get upset by "leaving money on the table." They give the intuition that the decision-makers of a firm sum the wealth loss of underpricing and counter with the wealth gained on retained shares, as prices usually increase in the aftermarket, this difference tends to be positive (Loughran & Ritter, 2002). This trend further benefits underwriters if investors engage in rent-seeking behavior to increase their chances of being allocated shares in the offering.

2.6 Hypotheses

Given our theoretical and empirical framework, this thesis aims to examine if the consensus that the pandemic adversely impacted financial markets apply to the IPOs in Norway and Sweden. We were inspired by the atypical assumption of the pandemic's beneficial impact on the IPO market and the lack of a comprehensive scholarly study examining IPOs in the Nordic market during COVID-19. Following the market observations and IPO theories, we expect higher underpricing and volatility for IPOs issued during the pandemic. Thus, we have in the following outlined four different hypotheses to test if the COVID-19 pandemic led to increased information uncertainty for Norwegian and Swedish IPOs.

2.6.1 Hypotheses development

The IPO boom in 2020 and 2021 is characterized by immense uncertainty and fear due to the COVID-19 pandemic. Following the literature by Ritter (1984), we expect higher levels of underpricing and post-IPO return volatility. Thus, we will start by establishing the significance of the COVID-19 pandemic and whether the pandemic led to greater information uncertainty by increased underpricing and volatility of IPOs issued post-COVID-19. As previous research has established the significance of the pandemic on financial markets and foreign IPO markets (Baig & Chen, 2022; Mazumder & Saha, 2021), we start by investigating its significance on IPOs in Norway and Sweden.

Hypothesis 1: COVID-19 had a statistically significant effect on information uncertainty affecting IPOs in Norway and Sweden.

Second, we wish to examine the correlation between the variations in pandemic intensity in underpricing and volatility by studying the significance of two COVID-19-related indexes. As research from Baig & Chen (2022) found that the pandemic intensity is positively associated with the underpricing and volatility of IPOs in the U.S., we expect the same for IPOs in Norway and Sweden. The theories indicate higher volatility and initial return during IPO frenzies as a consequence of greater information asymmetry (Lowry et al., 2010). Hence, we implement the number of cases and deaths to examine the level of pandemic intensity throughout 2020 and 2021, utilizing it as variables that might be of explanatory power of the expected change in information uncertainty.

Hypothesis 2: The COVID-19 intensity indexes, deaths, and cases, are explanatory variables for increased information uncertainty.

Further, we explore how underpricing and return volatility were affected by government responses as research from Adra (2021) found monetary policy essential in shaping the IPO market. The COVID-19 pandemic led to a global economic recession, and the government responses implemented to combat the situation are expected to be of significance. Furthermore, to test if government responses are a statistically significant factor for changes in the information uncertainty proxies, we utilize the Stringency index from the OxCGRT as the possible explanatory variable behind the induced information uncertainty.

Hypothesis 3: Government responses in Norway and Sweden are significant for induced information uncertainty.

Finally, we test whether government responses had a distinct impact in Norway and Sweden as the respective governments chose to tackle the crisis with different tactics. The countries unified some of the economic measures, but the level of restrictions and lock-down intensity varied throughout the pandemic.

Hypothesis 4: The severity of country-specific government responses has had a distinct impact in Norway and Sweden.

3.0 Data

In this part of the thesis, we will describe how we chose our data and the collection process of it. To answer our research question, the sample we collect must be correct and with credibility. Thus, our estimation and evaluation of induced information uncertainty affecting the IPOs in Norway and Sweden are reliable.

3.1 IPO data collection

For the empirical analysis, we focus on initial public offerings from 01.01.2018 until 01.01.2022 issued in Norway and Sweden. We included two pandemic years and two prior years to achieve enough variation in the explanatory variables (corona-related indexes). To answer our research question, we have included both regular initial public offerings and private placement (PP) IPOs. Private placements differ from public offerings as they only offer a small specific group of investors to invest in the IPO before going public. However, they have similar characteristics with the aim of raising new capital. During the pandemic, approximately 30% of all IPOs were private placements. Thus, the analysis will have reduced power and increased errors if not included, as they contributed to the sharp increase in IPO activity. Following this, it is crucial to recognize that adding private placements can have an adverse effect associated with less underpricing as they have significantly less risk of asymmetric information (Cai et al., 2011).

We exclude IPOs not traded on Oslo Børs, Euronext growth market, Spotlight Stock market, First North, or Nasdaq Stockholm. Thus, we end up with a sample size of 205 from Sweden and 100 from Norway for the baseline regression's initial return and volatility analysis. We decided to focus on Norway and Sweden as they have similar economic- and institutional characteristics. We found that both countries are transparent with their financial data and are all treated with respect. We collected all IPOs from the respective stock exchanges. Bloomberg L.P. provides us with price and financial data. We have also cross-checked with data from Thomson Reuters (Eikon) to assure credibility in numbers.

3.1.1 Marketplaces

We have chosen the above-mentioned stock exchanges to ensure a valid sample collection. It is essential to recognize that they have different requirements and standards that affect the pricing of the IPOs. However, with fewer requirements, it is harder to value the issue as you are more exposed to uncertainty due to a lack of transparency. This is also argued by IPO underpricing theory, as increased uncertainty will lead to a rise in underpricing (Beatty & Ritter, 1986). Therefore, we will go through the differences in the respective marketplaces in the following.

Oslo Market places

The Oslo Stock exchange operates the only regulated market for securities in Norway and is a world leader in several industries. The listing process includes a long formal process with strict requirements. First, the firms must have an approved EEA prospectus by Finanstilsynet, and the process requires financial transparency. Further, Oslo Børs will evaluate all documentation to see if all Bond rules' requirements are met (Euronext Group, 2022). Due to the time-consuming process, younger and growing firms choose other platforms. Hence, we include all IPOs issued on Euronext Growth which is also a part of the Euronext Group, but it is essential to distinguish between Oslo Børs and the Growth market. The increase in IPOs was significantly higher in the Euronext Growth Market, mainly due to fewer obligations and regulations than in Oslo Børs. The Euronext Growth market in Oslo is highly represented by younger and newly founded companies as the application process is only ten days, and therefore a quick solution in uncertain times when capital is needed (Johannessen, 2021). The marketplace requires less financial transparency from the firms. However, this can also lead to mispricing of the initial public offerings (AksjeNorge, 2022).

Stockholm Market places

Similar to Oslo Børs, Nasdaq Stockholm and Spotlight Stock market have stricter requirements for the listing process, where it can take up to months from initiating to going public (Spotlight, n.d.). However, Sweden also offers markets with fewer requirements and quicker listing processes, similar to Euronext Growth. Nasdaq offers a platform called Nasdaq first growth with a smooth listing process with a diversified investor group supporting the market (Nasdaq, n.d.). The First North and Growth market stood for 62% of all IPOs in Sweden from 2018 until 2021, and in the pandemic years, the markets with the shorter listing process and less stringent requirements had an increase of 84%.

3.2 Data and variable characteristics

After collecting the sample of IPOs, we need to find the relevant data, historical prices, and firm characteristics to conduct the empirical analysis. Hence, the following section will describe all pertinent information necessary to construct all relevant variables to analyze how the COVID-19 pandemic has impacted the underpricing and volatility of IPOs in Norway and Sweden.

3.2.1 Empirical design and dependent variables

Our analysis uses underpricing and volatility as proxies for information uncertainty. Thus, being the dependent variables of interest to explain the impact of the pandemic on information uncertainty in Norway and Sweden.

The first dependent variable, underpricing, is found by calculating the initial return of each IPO. We will have underpricing when the subscription price is issued at a discount to the realized market price after the security has started trading.

$$InitiaReturn_i = \frac{CP_t - OP_{t-1}}{OP_{t-1}} \tag{3.1}$$

$$where\ if\ InitialReturn_i > 0\ reveal\ underpricing$$

We adjust the initial return for interim market movements with the respective IPOs country-specific index. All IPOs from Norway will be adjusted to the Oslo SE All-share Index (OSEAX), whereas in Sweden, we will use the OMX Stockholm All-Share Index (OMXSPI). Several research papers debate whether it is necessary to adjust for market returns or not. However, we choose to include it as an unadjusted initial return will not account for changes that can cause the price to shift. As the period of study is affected by significantly higher market volatility, this is particularly important for our thesis. By doing so, we account for more factors influencing the changes, and we will find a more accurate reflection of the IPOs true initial return value (Corporate Finance Institute, 2020). Therefore, the initial return of the IPOs is computed using the offer price and unadjusted historical closing price, then adjusted for the respective market index.

$$InitialReturn_{i,NOR} = \left(\frac{CP_t - OP_{t-1}}{OP_{t-1}}\right) - \left(\frac{OSEAX_t - OSEAX_{t-1}}{OSEAX_{,t-1}}\right) \tag{3.2}$$

$$InitialReturn_{i,SWE} = \left(\frac{CP_t - OP_{t-1}}{OP_{t-1}}\right) - \left(\frac{OMXSPI_t - OMXSPI_{t-1}}{OMXSPI_{t-1}}\right) \tag{3.3}$$

$InitialReturn_i$ represents the specific firms' initial returns as a composite of CP_t being the closing price on the first trading day and OP_{t-1} as the offer price at the time of subscription. Similarly, we adjust for market movements of the country-specific index $OSEAX_t$ or $OMXSPI_t$ being the closing value of the index on the first trading day and $OSEAX_{t-1}$ or $OMXSPI_{t-1}$ being the market value of the index at the pricing date of the shares.

Further, we will use the standard deviation of each IPO's first 30 daily returns to estimate the volatility, thereby being the second dependent variable. Excluding the first-day initial return limits the effect of fluctuations in the volatility measure. The volatility is not adjusted for market volatility, as the secondary market volatility will have a minor influence compared to other factors when determining the volatility (Lowrey et al., 2010).

$$\sigma_i = \sqrt{\frac{\sum \left|CP_t - \overline{CP}_t\right|^2}{n}} \tag{3.4}$$

σ_i represents the IPOs standard deviation over n=30 days and CP_t being the closing price of each trading day. The volatility will give us an additional explanatory variable for the likely induced information uncertainty caused by the pandemic. The difficulty of forecasting the distribution of returns, including the long-term mean, is commonly measured by information uncertainty; as this paper focuses on the short-term effects on IPO performance, there is likely a positive correlation to the volatility measure. The volatility quantifies the dispersion of short-term shocks around the long-term mean (Ait-Shalia et al., 2021). We expect there to be higher volatility in 2020 and 2021, as we are in a hot market, where the risk of information asymmetry is significantly higher due to the COVID-19 pandemic.

3.3.2 Descriptive statistics dependent variables

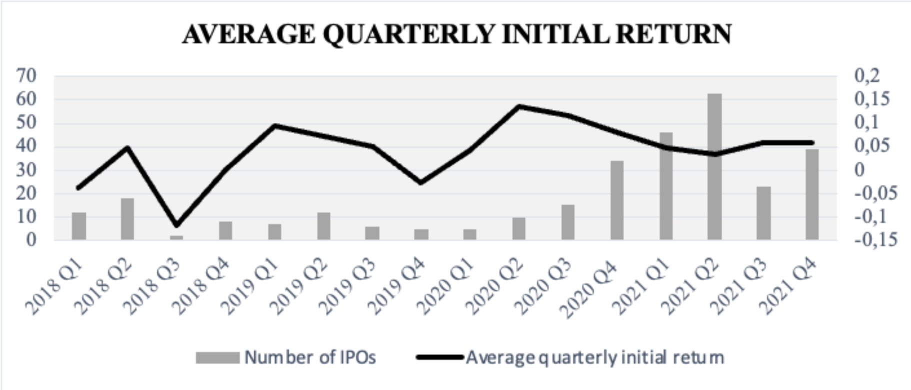

Figure 5: Average quarterly initial return. *The graph illustrates the average number of IPOs in Norway and Sweden (represented on the LHS of the y-axis) and the percentage of average adjusted Initial Return (represented on the RHS of the y-axis) quarterly from 2018 until 2021 (represented on the x-axis). In 2018-2019 there were an average of 9 IPOs per quarter, whereas, in 2020-2021, we had a quarterly average of 29 IPOs. On average, underpricing increased approximately 6% during the COVID-19 pandemic, with an all-time high in Q2 2020 with 9.6% greater underpricing than Q1 2020. The underpricing volatility increased by approximately 5% in 2020 compared to 2019 before it stabilized throughout 2021.*

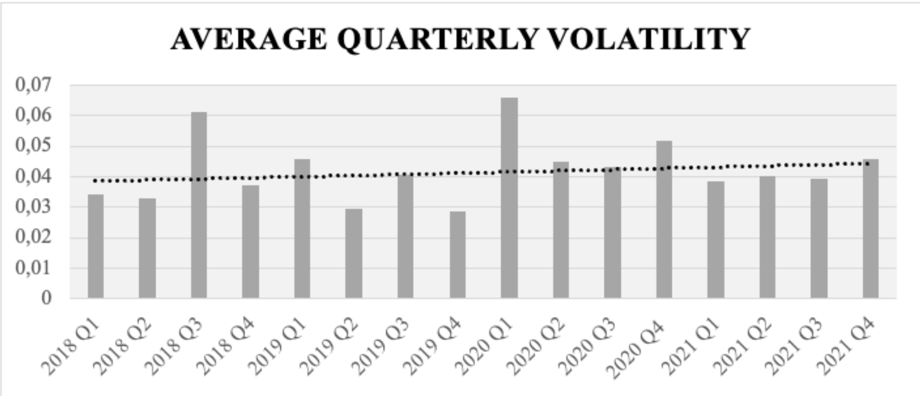

Figure 6: Average quarterly volatility. *The table illustrates the average quarterly volatility (represented on the y-axis) from 2018 to 2021 (defined on the x-axis). In 2018 and 2019, we had average volatility of 3.8%. In 2020 the volatility increased by 1,5% and evened out in 2021 with an average volatility of 4.1%.*

3.3.3 Corona data collection

We use three different pandemic-related indexes retrieved from the Oxford COVID-19 Government Response Tracker (OxCGRT). The OxCGRT aims to compare different policy responses rigorously and consistently. Since January 1, 2020, the responses have been tracked and categorized into 23 indicators, including school closures, travel limitations, and vacation policies. These policies are assigned a score to measure the magnitude of government intervention, and the results are compiled into a set of policy indices. The goal is to track and evaluate global government actions against the coronavirus and systemize data on the government's precautions, assisting pandemic response efforts (University of Oxford, 2020).

We separated the indexes into two categories: pandemic- and government response intensity. To measure the pandemic intensity, we use the 30-day equally-weighted average of new cases and deaths in Norway and Sweden before the IPO issue day. Thus, indicating the pandemic intensity level at the point of the offering. Thereafter, we utilize the stringency index, measuring the intensity of COVID-19-related government responses. The index is calculated using all ordinal containment and closure policy metrics and a public awareness campaign indicator. Similar to the case and death indexes, we find the 30-day equally-weighted average from Norway and Sweden. Following, we inspect the countries' respective stringency indexes separately. Further, we take the natural log of one plus the index to secure linearity and reduce outliers.

$$Index_{cases} = AVERAGE_{30days}[\ln(number\ of\ cases_t + 1)] \tag{3.5}$$

$$Index_{death} = AVERAGE_{30days}[\ln(number\ of\ deaths_t + 1)] \tag{3.6}$$

$$Index_{stringency} = AVERAGE_{30days}[\ln(Stringency\ index_t + 1)] \tag{3.7}$$

By observing the changes in the three corona-related indexes represented in *Figure 7* and *Figure 8*, we notice a similar trend in the death- and stringency index. This is expected as government interventions followed the increase in hospitalizations and deaths.

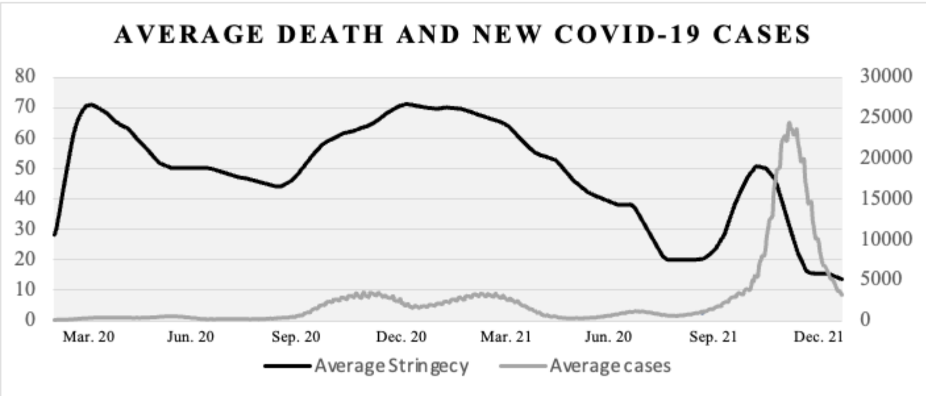

Figure 7: Average death and new COVID-19 cases. *The graph illustrates the average Stringency index in Norway and Sweden (represented on the LHS of the y-axis) plus the average number of cases calculated by a thirty-day rolling average in both countries (represented on the RHS of the y-axis) from the 1st of March 2020 until the 31st of December 2021 (represented on the x-axis).*

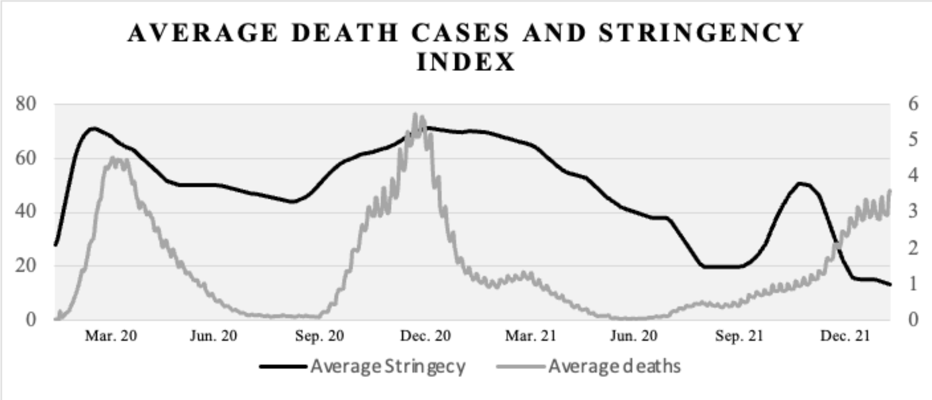

Figure 8: Average death cases and Stringency Index. *The graph illustrates the equally-weighted average death cases (represented on the RHS of the y-axis) and the equally-weighted average Stringency Index in Norway and Sweden (represented on the LHS of the y-axis) from 1st of March 2020 until the 31st of December 2021 (represented on the x-axis). Average death and cases are calculated over a 30-day rolling average. We observe a trend in the two indexes. The trend can be explained by governments acting following the increase in hospitalizations and deaths.*

3.3.3 Dummy variables

The initial focus of our test will be the COVID factor to test the first hypothesis; that the pandemic has significantly affected IPOs in Norway and Sweden. From our data sample, approximately 75% of all IPOs are issued during the pandemic. We include dummy variables to help categorize the data and results. The covid dummy equals one when the IPO is issued after March 2020 and zero otherwise.

Following IPO literature, we will account for Greenshoe options (GSO) by including it as a dummy in the regression model, being one if GSO and zero otherwise. A Greenshoe option allows the underwriter to over-allocate, meaning that they offer investors more shares than initially planned (Baker, 2020). Over-allotment options are typically used when the demand for the issue is higher than expected, where the underwriter can sell up to 15% more shares of the issue to investors (Smith, 2022). The significance of a GSO is evident, and it is therefore considered in our analysis. If GSO is exercised, they are usually harder to value due to increased uncertainty before the trading day resulting in higher underpricing of the IPO. From our sample, we see that there are 93 IPOs that have exercised a GSO, and we know that they are, on average, 9.60% more underpriced. The frequency of GSO increased by approximately 8% during the pandemic relative to the years before.

During the pandemic, we saw that 22.30% of all IPOs were tech companies. The IPOs will be classified according to the Industry Classification Benchmark (ICB), which is adapted in all stock exchanges we have retrieved information from (Kenton, 2019). Hence, we include it as a dummy variable in our model, equal to one if the company operates in the tech industry and zero otherwise.

Lastly, we include Norway as a dummy, equal to one if IPO is issued in Norway and zero otherwise. We include it as a dummy to account for Swedish IPOs being historically more underpriced than Norwegian IPOs. From our full sample period, Sweden stands for approximately 66% of the IPOs, expected as they are a larger economy. Furthermore, we observe that Norway had approximately 30% more IPOs during the pandemic relative to the previous years compared to Sweden.

	(1) Full Period (n=305)		(2) Pre COCID-19 (n=77)		(3) Post COVID-19 (n=228)	
	Frequency	%	Frequency	%	Frequency	%
Covid	*228*	*74.75%*	*0*	*0.00%*	*228*	*100%*
GSO	*93*	*30.49%*	*19*	*24,67%*	*74*	*32.46%*
Tech	*68*	*22.30%*	*14*	*18.18%*	*54*	*23.68%*
Norway	*100*	*32.29%*	*15*	*19.48%*	*85*	*37.28%*

Table 1: Summary statistics dummy variables. *The table presents summary statistics for all dummy variables relevant for to model. The sample is divided into three groups (1) the full period, with all 305 observations (2) all 77 IPOs issued pre-COVID-19 before March 2020. (3) All 228 IPOs issued during COVID-19 after March 2020. For each period, we find the frequency in terms of amount and percentage for the respective period for each dummy variable. Covid equals one if IPO is issued post-COVID-19 and zero otherwise. GSO equals one if overallotment option, and zero otherwise. Tech equals one if IPO is in the tech industry (using the ICB classification) and zero otherwise. Norway equals one if the IPO is issued in Norway and zero otherwise.*

3.1.4 Control variables

To better assess the effect of our key independent variables, we introduce control variables presented in the following section to prevent alternative explanations for underpricing and volatility during pandemic times. The control variables included are carefully chosen based on the theoretical framework presented for IPO performance. The model comprises seven variables relevant to the different IPO characteristics. We control for the IPO firm's age, proceeds, assets, volume, market capitalization, and offer price. By including them, we help establish and enhance the internal validity of how pandemic-induced uncertainty has affected the underpricing of IPOs in Norway and Sweden. All numbers and prices relevant for each control variable have been retrieved directly from Bloomberg L. P.

Offer size of the IPO is included as it will reduce the systematic risk. From earlier research by Ritter (1984), we have seen a negative correlation between the offered size and underpricing. Moreover, the proceeds can be seen as a measure of uncertainty, as risk will correlate with the issue size. We employ a proxy for the size of the offering, where we subtract the number of shares issued in the IPO by the total number of shares before the IPO. Thereafter multiplying with the offer price, before dividing by the Market Capitalization of the firm.

$$Offer\ Size = \frac{(Shares_{t-1} - Shares_t) * OP_t}{MarketCap} \tag{3.8}$$

Firm Age is included to account for the increased information asymmetry of younger firms (Ritter, 1984). After the pandemic outbreak, several young firms decided to go public as they required new and induced financing capacity to survive and manage well through the crisis. The firm age equals the IPO year, subtracting by the founding year. To ensure linearity, we take the natural log plus one.

$$\ln(FirmAge) = \ln[(IPOyear - FoundeingYear) + 1] \tag{3.9}$$

Similar to firm age, ***Market Capitalization*** or company size is added to encounter information asymmetry. The variable can also be seen as a forecast of the degree of uncertainty, indicating higher underpricing (Beatty & Ritter, 1986). We will multiply the number of outstanding shares with the offer price to find a proxy for the variable.

$$\ln(MarketCap) = \ln\left(Shares_{outstanding} * OP_t\right) \tag{3.10}$$

Following research from Loughran & Ritter (2004), we include ***Return on Assets*** (ROA) and ***Total Assets*** for each IPO to account for firm characteristics. The purpose; consider firm sizes, as larger firms suffer less from information asymmetry (Barth & Kaznik, 1999; Zhou & Sadegi, 2019).

Lastly, we control for ***Offer Price*** and **Trading Volume**. The offer price of the IPO is included as earlier research has found that it can be an indicator of risk related to the IPO (Beneveniste & Sprindt, 1989). Initial public offerings with higher prices are usually more underpriced (Ibbotson et al., 1994; Booth & Chua, 1996). Trading Volume is controlled for as higher trading volume indicates greater investor demand and optimism (Lowry, 2003; Baker & Wurgler, 2007). We find the trading volume for the first 30 days after the first trading day of the IPO. This will be naturally logged to ensure linearity.

3.1.2 Descriptive statistics independent variables

	Mean	*Median*	*Std*	*Min*	*Max*
Full period (n= 305)					
Age	*19.00*	*12.00*	*24.05*	*-*	*181.00*
Assets	*524.61*	*50.80*	*2 599.61*	*-*	*31 407.50*
Mkt. cap	*390.44*	*83.19*	*1 423.52*	*2.22*	*18 370.35*
Offer price	*49.38*	*23.50*	*297.39*	*0.35*	*5 201.00*
Offer size	*0.35*	*0.33*	*0.19*	*0.02*	*0.94*
ROA	*-11.51*	*-*	*31.44*	*-223.90*	*58.70*
Volume in 1000	*312.16*	*28.45*	*1 391.83*	*0.96*	*16 219.70*
Pre COVID-19 (n= 77)					
Age	*17.45*	*12.00*	*23.18*	*-*	*153.00*
Assets in ml.	*741.98*	*51.00*	*2 274.26*	*-*	*16 222.60*
Mkt. cap in ml.	*332.64*	*57.38*	*1 052.38*	*2.22*	*6 568.45*
Offer price	*30.18*	*22.00*	*27.77*	*0.35*	*176.50*
Offer size in ml.	*0.32*	*0.31*	*0.16*	*0.02*	*0.92*
ROA	*-16.68*	*-0.60*	*31.06*	*-94.80*	*32.90*
Volume in 1000	*414.21*	*27.80*	*1 880.17*	*1.58*	*16 219.70*
Post COVID-19 (n=228)					
Age	*19.52*	*11.50*	*24.36*	*-*	*181.00*
Assets in ml.	*451.2*	*49.58*	*2 701.34*	*-*	*31 407.50*
Mkt. cap in ml.	*409.95*	*90.45*	*1 530.19*	*3.56*	*18 370.35*
Offer price	*56.47*	*25.00*	*343.52*	*1.20*	*5 201.00*
Offer size in ml	*0.36*	*0.33*	*0.20*	*0.03*	*0.94*
ROA	*-9.77*	*-*	*31.45*	*-223.90*	*58.70*
Volume in 1000	*278.21*	*31.92*	*1 185.66*	*0.96*	*13 440.14*
LnCase	*5.17*	*5.31*	*0.68*	*3.81*	*7.33*
LnDeath	*0.38*	*0.34*	*0.22*	*0.05*	*1.20*
LnStringency	*3.86*	*4.00*	*0.39*	*3.04*	*4.28*

Table 2: Descriptive statistics independent variables. *The table presents summary statistics for all independent variables. The sample is divided into three categories: (1) average of all 305 IPOs in the full-time period. (2) all 77 IPOs issued pre-COVID-19 before March 2020. (3) All 228 IPOs issued during COVID-19 after March 2020. All values are represented in USD. Age is the IPO issue year minus the founding year. Assets represent a firm's total assets in million. Market Capitalization is a proxy for the firm's value in million. Offer price is the price of the security at offering. Offer Size is the number of shares offered by the issuer in million. ROA (Return on Assets) represents the firm´s profitability. Volume is the trading volume of the 30 first day after offering. LnCase (LnDeath) is the 30-day equally-weighted average of number of cases (death cases) in Norway and Sweden before IPO. LnStringency is the 30-day equally-weighted average of the index in Norway and Sweden before IPO.*

4.0 Methodology

In the following section, we describe the methodology behind our analysis. As sample construction, relative variables, and empirical design have been presented; we focus on the econometric strategy and concerns in this section.

4.2 Econometric strategy and concerns

We estimate three different multiple linear regression models to test our hypotheses. We are further running these models 12 times combined to evaluate our proxies for induced information uncertainty in relation to our hypotheses. We will use the ordinary least square (OLS) estimator for the model parameters, as we can test the relationship between our dependent and independent variables. By using the estimator, some assumptions must be fulfilled (Wooldridge, 2019):

1: There must be linearity in the parameters. As we in the regression intend to fit a hyperplane to explain the relationship between the dependent and independent variable, linearity is required. To ensure linearity, we take the natural log of all relevant variables; as mentioned earlier, this will also reduce outliers where $E\left(X_i^4\right) < \infty$ and $E\left(IUC_i^4\right) < \infty$ in the model. The dependent variables, dummy variables, and some control variables will not be logged.

2: Random sampling is necessary. Meaning that $(X_i, Y_i), i = 1, \ldots, n$ must be random and equally chosen. The number of observations taken should also be greater than the number of parameters estimated, as it is in our data with 305 IPOs. All independent variables are also fixed, meaning that they all impact the dependent variable in the regression. Moreover, we expect a causal relationship.

3: Given the independent variables, the expected value of the error term in the regression should be zero. Hence, the following equation must be fulfilled with $E(u_i|X_i) = 0$, where X_i represents the independent variables. This tells us that the error term is independent of the chosen independent variables meaning that there is no correlation, and the independent variables are exogenous.

4: There must be no correlation between the independent variables as we run a multiple linear regression. If there is a strong correlation between some of the variables, this can cause trouble when running the OLS regression. Hence, the independent variables we have described are carefully chosen to secure sufficient variation, leading to a better estimate of the information uncertainty.

5: The error terms in the regression should have the same variance. If $Var(u_i|X_i) = \sigma^2$ is true, we will have homoscedasticity, giving us a more concise and correct OLS estimate. Further, we assume no autocorrelation, as the observations of different error terms are not correlated. This is true if $Cov(u_i u_j|X_i)\ for\ i \neq j$ holds.

Conclusively, we ensure that all assumptions hold for the regression to fortify validity. If this is true, we will have a Best Linear Unbiased Estimator (BLUE) for information uncertainty according to Gauss-Markov Theorem (Wooldridge, 2019).

4.3 Correlation Matrix

Concerning the OLS assumptions above, we account for the dummy variable trap and multicollinearity by checking the correlation between all independent variables included in our thesis. We observe several correlations that must be recognized to guarantee credibility in our analysis.

	lnCap	lnAge	lnAssets	lnVolume	OfferPrice	OfferSize	ROA	Covid	GSO	Tech	NOR
lnCap	1.000										
lnAge	0.285	1.000									
lnAssets	0.732	0.262	1.000								
lnVolume	0.509	0.014	0.511	1.000							
OfferPrice	0.040	0.008	0.007	-0.081	1.000						
OfferSize	0.047	-0.111	0.089	0.139	-0.021	1.000					
ROA	0.389	0.218	0.401	0.099	-0.028	-0.016	1.000				
Covid	0.090	0.008	-0.095	0.015	0.039	0.106	0.096	1.000			
GSO	0.573	0.326	0.468	0.249	-0.001	0.178	0.219	0.073	1.000		
Tech	0.043	0.040	-0.021	0.053	-0.023	-0.075	0.048	0.057	0.141	1.000	
NOR	0.336	-0.035	0.279	0.332	0.079	-0.044	0.171	0.166	0.008	0.096	1.000

Table 3: Correlation Matrix of all independent variables. *Age is the IPO issue year minus the founding year. Assets represents a firm's total assets in million. Market Capitalization is a proxy for the firm's value in million. Offer price is the price of the security at offering. Offer Size is the number of shares offered by the issuer in million. ROA (Return on Assets) represents the firms profitability. Volume is the trading volume of the 30 first day after offering. LnCase (LnDeath) is the 30-day equally weighted average of number of cases (death cases) in Norway and Sweden before IPO. LnStringency is the 30-day equally weighted average of the index in Norway and Sweden before IPO.*

The correlation coefficient between market capitalization (lnCap) and total assets (lnAssets) is relatively high and shows a coefficient of 0.73. Furthermore, we see a medium-strong correlation of 0.573 between market capitalization (lnCap) and Greenshoe option (GSO), followed by 0.509 between market capitalization (lnCap) and trading volume (lnVolume) and 0.47 between market capitalization (lnCap) and offer size (offersize). The same association is seen in the correlation coefficient of total assets (lnAsset), which shows a medium-strong correlation to both trading volume (lnVolume), return on assets (ROA), and greenshoe option (GSO) of 0.511, 0.401, and 0.468, respectively. A high correlation between market capitalization and total assets is expected as both variables can be deemed a proxy for company size. The medium-high correlation between the two proxies for company size, trading volume, and offer size are not surprising, as these variables are closely related. Moreover, Greenshoe options are more usual for larger firms and issues of a relatively big size. Although the variables show signs of a potential collinear relationship, this is not necessary of concern as these are employed as control variables and do not influence the inference of our research variables.

In addition, even though most pairwise correlations are small, a strong linear relationship may exist between four or more variables. Consequently, we further inspect this relationship by calculating the VIFs (variance inflation factors) for all the explanatory variables. These values start at one, which indicates that the respective variable does not correlate with any other variables. A VIF value between 1-5 indicates a moderate correlation. However, it is not severe enough to begin any corrective measures. A VIF value above 5 indicates significant levels of multicollinearity where the result is poorly estimated coefficients and questionable p-values (Frost, 2021). The highest VIF value obtained for our sample is 3.83, observed for lnCap, indicating that multicollinearity is not a concern in our data sample (see *Table 9*, *Appendix 2*).

4.4 Regressions

This subsection presents the regression models used to test our hypothesis. The regressions are linear OLS models, giving us a predicted linear result of the dependent variables as a measure of information uncertainty.[3] Therefore, each

[3] Further variable description can be found in Table *8*.

equation will be run twice, once for the underpricing proxy and then for the volatility proxy. All regressions will include the same control variables mentioned in the data section to ensure results with a greater explanatory power. As stated, some variables are naturally logged to ensure linearity and reduce outliers. Further, we will use the 99th percentile to exclude extreme values for the dependent variables, to get more representative estimations. We add the error term u_t for every regression to avoid a deterministic equation and increase its explanatory power.

To test the first hypothesis and determine the significance of COVID-19 on Norwegian and Swedish IPOs, we will start by checking if COVID-19 has induced information uncertainty for either of our proxies, underpricing, and volatility. To test the first hypothesis, we construct a model where $Covid_i$ is a dummy equal to one if the IPO issue day is after March 2020, and zero otherwise. Further, we include the dummies $Greenshoe_i, Tech_i$ and $Norway_i$ to account for IPOs characteristics that might have explanatory power for the variation in our dependent variables. Further explanation of the variables can be found in *Appendix 1, Table 8.*

$$\begin{aligned} IU_i = \alpha_0 + \beta_1 Covid_i + \beta_2 Greenshoe_i + \beta_3 Tech_i + \beta_4 Norway_i \\ + \beta_5 OfferSize + \beta_6 \ln FirmAge_i + \beta_7 \ln MartketCap_i \\ + \beta_8 \ln TotalAssets_i + \beta_9 ROA_i + u_i \end{aligned} \tag{4.1}$$

The model represents the information uncertainty, IU_i, utilizing the two proxies; underpricing and post-IPO stock volatility for each IPO. It is expected that this will be significantly greater when the $Covid_i$ dummy equals one, indicating greater information uncertainty as a consequence of the pandemic.

Further, we examine how the three COVID-19-related indexes affect our dependent variables. Thus, we will only examine post-COVID-19 IPOs to assess the effect of the pandemic intensity and government responses. To test our hypothesis, we add the different corona-related indexes to our regression to establish their explanatory power behind the likely increased information uncertainty. We run the model three times, once for the number of cases, deaths, and Stringency level. As mentioned, we take the natural log plus one before calculating the equally-weighted indexes' average 30 days before the listing date in both countries. The computations are outlined in *(*3. 5*), (3. 6)* and *(*3. 7*).*

$$IUC_i = \alpha_0 + \beta_1 Index_i + \beta_2 Greenshoe_i + \beta_3 Tech_i + \beta_4 Norway_i + \beta_5 OfferSize_i + \beta_6 lnFirmAge_i + \beta_7 \, ln \, MartketCap_i + \beta_8 \, ln \, TotalAssets_i + \beta_9 ROA_i + u_i \tag{4.2}$$

In the regression, IUC_i represents the information uncertainty of the issue during the COVID-19 pandemic. $Index_i$ represents the key independent variables related to the COVID-19 intensity and intervention indexes for different specifications.

Lastly, to test our last hypothesis, that the country-specific governments have had a distinct impact in Norway and Sweden, we reconstruct the COVID-19-related Stringency index to assess its effect in the two countries separately. We apply the same formula as presented above (4. 2), only separating the country-specific index. In this regression, we exclude the Norway dummy as it is no longer relevant. All other variables are still the same. Thus, we will be able to examine differences in how government restrictions impacted the information uncertainty of IPOs in Norway and Sweden.

$$IUC_{NOR} = \alpha_0 + \beta_1 Covid_i + \beta_2 Greenshoe_i + \beta_3 Tech_i + \beta_4 Norway_i + \beta_5 OfferSize + \beta_6 \ln FirmAge_i + \beta_7 \ln MartketCap_i + \beta_8 \ln TotalAssets_i + \beta_9 ROA_i + u_i \tag{4.3}$$

$$IUC_{SWE} = \alpha_0 + \beta_1 Covid_i + \beta_2 Greenshoe_i + \beta_3 Tech_i + \beta_4 OfferSize + \beta_5 \ln FirmAge_i + \beta_6 \ln MartketCap_i + \beta_7 \ln TotalAssets_i + \beta_8 ROA_i + u_i \tag{4.4}$$

IUC_{NOR} and IUC_{SWE} represent the country-specific effect on each IPOs information uncertainty. The regressions utilize two different datasets, one containing all Norwegian IPOs, and one containing all Swedish IPOs, both reflecting IPOs issued during the pandemic years, respectively.

5.0 Analysis and Results

In the following section of the thesis, we present our empirical results and findings of how the COVID-19 pandemic has affected the information uncertainty of Norwegian and Swedish IPOs. In the previous sections, we have described the dependent and independent variables with descriptive statistics used to perform a thorough analysis following our econometric strategy and potential concerns. We analyze our regression results, identifying variables of interest and their association with the dependent variables; adjusted initial return and post—IPO return volatility. Subsequently, we discuss the regression outputs, possible explanations, and important limitations of the conducted research, together with suggestions for future research.

5.1 The significance of the pandemic

By analyzing our sample of 305 IPOs and examining the market-adjusted initial return and post-IPO return volatility as a measure of information uncertainty, it is clear that both dependent variables are significantly affected by the COVID-19 pandemic. Accessing our results, we must recognize uncertain times and market conditions that may affect our results of the proxies for information uncertainty in the years before the COVID-19 pandemic. In *Figure 5*, we observe a drop in underpricing in the second half of 2018, followed by a peak in Q1 2019 due to a global economic slowdown (Lewis, 2019). Consequently, we observe a boom in underpricing, where IPOs issued in the first quarter of 2019 experienced 9% greater underpricing than the last quarter in 2018. For 2020, we saw the same trend; however, it was now more significant, with IPOs in the second quarter being 10% more underpriced on average than in the first quarter. Indicating that the announcement of COVID-19 as a pandemic created immense uncertainty affecting the IPO underpricing. We see that the fluctuations in underpricing are more prominent in the first quarters of the pandemic. However, it stabilized throughout the end of 2020 and 2021, though remaining at a higher level than before, with IPOs issued post-COVID-19 being 7% more underpriced on average. Thus, indicating the severity of the first shock caused by the pandemic.

The volatility proxy is also highly impacted by market-induced uncertainty. The observed increase in volatility indicates higher dispersion of the 30-day closing prices, increasing the risk related to the public offering (Wagner, 2022). In 2018 and 2019, we had average volatility of 3.8% and a peak in Q3 2018 following the global economic slowdown inducing uncertainty. In 2020 we had a 1.5% increase in volatility measure, where the first quarter of 2020 had a peak of 6.6% on average (ref. *Figure 6*).

5.1.1 Distribution of first-day returns

In terms of mean, standard deviation, and other statistical measures, the difference between simple initial return and market-adjusted initial return is minor, ranging from a percentage change of 0,34% to 0,65% in the mean and only 0,07% to 0,29% in the median (*Table 4).* The negligible differences in the two measures are expected, as the pricing date of the issue typically is followed by being listed on an exchange shortly after.

	Full period (n=305)		Pre COVID-19 (n=77)		Post COVID-19 (n=228)	
	IR	*Adj. IR*	*IR*	*Adj. IR*	*IR*	*Adj. IR*
Mean	*5.59%*	*5.25%*	*0.55%*	*1.11%*	*7.29%*	*6.65%*
Std	*19.01%*	*19.09%*	*17.38%*	*16.60%*	*19.27%*	*19.70%*
Min	*-29.64%*	*-35.34%*	*-29.64*	*-3.89%*	*-28.57%*	*-35.34%*
P25	*-6.25%*	*-6.09%*	*-9.14%*	*-7.72%*	*-4.12%*	*5.49%*
Median	*2.33%*	*2.47%*	*-0.80%*	*-1.09%*	*4.04%*	*3.97%*
P75	*16.94%*	*16.23%*	*10.98%*	*9.32%*	*20.00%*	*18.80%*
Max	*54.71%*	*53.10%*	*50.00%*	*48.94%*	*54.71%*	*53.10%*
Kurtosis	*2.7692*	*2.8494*	*3.2774*	*3.6701*	*2.6436*	*2.6687*
Skewness	*0.4163*	*0.3848*	*0.5278*	*0.5509*	*0.3605*	*0.2991*

Table 4: Descriptive statistics initial returns. *The table presents a summary statistic of the dependent variable underpricing. The sample is divided into three categories: (1) average of all 305 IPOs in the full period of time. (2) all 77 IPOs issued pre COVID-19, meaning IPOs before March 2020. (3) All 228 IPOs issued during IPO, IPOs after March 2020. It includes simple initial return (IR) and marked adjusted initial return (Adj. IR) for each period. We include the market adjusted IR, which is adjusted for interim market movement, by using the IPOs country-specific index (OSEAX or OMXSPI). IPOs issued post COVID-19 have, on average, 7% more underpricing than those issued prior COVID-19.*

As seen in *Table 4* there is a 5.54% increase in adjusted returns for IPOs issued during COVID-19 compared to IPOs issued prior to COVID-19. Indications of increased information uncertainty due to the pandemic are even more evident when looking at the mean in the same periods, where the market-adjusted return is -1.09% for the pre-COVID IPOs sample and 3.97% for the post-COVID sample. Hence, the lower half of the IPOs issued pre-COVID experienced negative returns lower than -1.09%, while the higher half of the post-COVID IPOs experienced more than 3.97% returns.

Given that the median is significantly lower than the mean, our three data samples are slightly skewed to the right. This is further supported by skewness and kurtosis values of 0.38 and 2.85 for the whole sample, respectively. Moreover, this suggests that the positive returns are greater than the negative ones, which is confirmed by looking at the distribution of returns in *Figure 9, Appendix 3.* Furthermore, our distribution is said to be platykurtic, meaning that it is somewhat flatter and broader than a normal distribution, confirmed by a kurtosis value of less than three.

5.1.2 COVID-19 Regression

To determine the significance of COVID-19 on information uncertainty, we run the regressions outlined in *(4. 1)* for both proxies; underpricing and volatility. We find that the COVID-19 dummy is statistically significant at a 5% level for both dependent variables. The positive coefficients on the COVID-19 dummy indicate that IPOs issued during the pandemic were exposed to a higher degree of information uncertainty versus IPOs issued before the pandemic. In other words, the market-adjusted initial return and post-IPO stock return volatility were both positively affected by the COVID-19 pandemic, supporting our first hypothesis that IPOs issued during the pandemic were more exposed to information uncertainty, leading to a higher degree of underpricing and volatility.

When analyzing our results, it is essential to recognize the significance of the different measure outputs indicating the explanatory power behind the different regressions. Therefore, it is vital to examine and recognize the R-squared measure of the model, as it determines the proportion of the variation of the dependent variable that the independent variables can explain. In other words, it tells us how well our data sample fits the regression model (Corporate Finance Institute, 2022). In our two models, we observe R-squared values of 0.124 and 0.393. When examining other relevant research papers that explore either IPOs alone or in relation to the pandemic, we conclude that the two models have a satisfactory explanatory power (following; Mazumder & Saha, 2021; Baig & Chen, 2022; Akyol et al., 2014; Beatty & Ritter, 1986). Furthermore, both our models are statistically significant, with F-values of 3.87 and 17, respectively. Hence, we conclude that our two models and the COVID-19 variable are statistically significant in explaining the variation in our two proxies for information uncertainty, further supporting our first Hypothesis 1**.**

	(1) Underpricing	(2) Volatility
Covid	*0,.059*** *(2.28)*	*0.007*** *(2.56)*
Greenshoe dummy	*0.082**** *(2.72)*	*0,000* *(0.01)*
LnAssets	*0.014* *(1.45)*	*-0.003**** *(-2.73)*
LnMarket Cap.	*-0.016* *(-1.23)*	*-0.005**** *(-3.74)*
LnVolume	*0.013*** *(1.99)*	*0.004**** *(6.25)*
LnFirmAge	*-0.010* *(-0.91)*	*0.001* *(1.09)*
OfferSize	*-0.068* *(-1.16)*	*-0.041**** *(-6.55)*
Norway dummy	*-0.021* *(-0.83)*	*-0.002* *(-0.72)*
ROA	*0.001** *(1.71)*	*-0,000*** *(-2.48)*
Offer price	*0.000**** *(3.09)*	*0,000* *(1.08)*
Tech dummy	*0.011* *(0.41)*	*0.000* *(0.34)*
Intercept	*0.136* *(0.67)*	*0.105**** *(4.90)*
N	*305*	*305*
R-squared	*0.127*	*0.393*
Adj. R-squared	*0.094*	*0,37*
F-Statistic	*3.87****	*17,00****
		*Note: *p<0.1; **p<0.05; ***p<0.01*

Table 5: Impact of COVID-19 on IPO information uncertainty. *The table presents the results of equation (4. 1). We use underpricing and volatility as dependent variable proxies for information uncertainty. The key independent variable is the covid-dummy, being one if IPO is issued after March 2020, and zero otherwise. Numbers in parentheses are t-statistics. *, ** and *** indicates statistical significance at a 10%, 5% and 1% level. Age is the IPO issue year minus the founding year. Assets represent a firm's total assets in million. Market Capitalization is a proxy for the firm's value in million. Offer price is the price of the security at offering. Offer Size is the number of shares offered by the issuer in million. ROA (Return on Assets) represents the firms profitability. Volume is the trading volume of the 30 first day after offering. LnCase (LnDeath) is the 30-day equally-weighted average of the number of cases (death cases) in Norway and Sweden before IPO. LnStringency is the 30-day equally-weighted average of the index in Norway and Sweden before IPO. Further definition of all variables can be found in Appendix 1- Table 8)*

In regression (1), we see that the intercept has a coefficient of 0.136 (13.6%), which is interpreted as the average underpricing given that all our independent variables were zero. Furthermore, due to the inclusion of the COVID-19 dummy, the intercept represents IPOs issued both before and after the pandemic outbreak. Nonetheless, we cannot proclaim that our constant is statistically different from zero as it is insignificant. As expected, the Greenshoe dummy is statistically significant at a 1% level with a coefficient of 0.082, indicating that IPOs with GSO options are, on average, 8.2% more underpriced. We also see that the variables LnVolume, Offerprice, and ROA are statistically significant at 5%, 10%, and 1%, respectively. As anticipated, all three coefficients have a positive sign, indicating that an increase in the variables consequently increases the degree of underpricing.

Moreover, the variables LnAge, Offersize, and LnMarket Cap all have the expected negative signs, indicating that older and larger firms are less underpriced. In contrast, LnAssets does not have the anticipated negative sign, indicating that companies with a large degree of physical assets experience more underpricing. However, not statistically significant, the latter mentioned variables have a decent P-value, suggesting that they all have a decent explanatory power on our dependent variable. The Tech and Norway dummy further has the lowest statistically significant relationship to our dependent variable. However, the coefficients align with our expectations, namely that tech firms experience a higher degree of underpricing and that IPOs issued in the Norwegian market experience less underpricing.

Regression (2), in contrast to regression (1), shows an intercept significant at a 1% level with a coefficient of 0.105, indicating that the average 30-day post-IPO stock return volatility is equal to 10.5%, given that all our independent variables equal zero. In this model, LnAssets, LnMarket Cap, Offersize, and LnVolume are statistically significant at a 1% level. The coefficients align with our expectations, namely, that a rise in the variables relating to the company- and issue size decreases return volatility and that a rise in trading volume increases return volatility. The variable ROA is significant on a 5% level; however, the coefficient seems to have a low effect on the dependent variable. Similarly, the coefficients for Tech, Norway, Greenshoe, and Offerprice indicate that variables have little to no effect on the dependent variable. Neither of the variables are statistically significant in explaining the volatility variation. Interestingly, our variable LnAge has a positive coefficient. In contrast to our expectations, older firms experience more post-IPO return volatility. Nevertheless, the variable is not statistically significant, and the coefficient seems to have little effect on volatility.

5.2 The COVID-19 indexes

We have established that the COVID-19 pandemic led to increased information uncertainty in Norway and Sweden from our analysis of IPOs issued both before and after the pandemic declaration. Thus, we examine the different COVID-19-related indexes and their significance on our two proxies for information uncertainty during the pandemic years. We run the regression outlined in *(4. 2)* for both proxies of Information Uncertainty and the three COVID-19-related indexes; the number of cases, deaths, and the Stringency index.

Concerning our second hypothesis, testing the pandemic intensity's significance on information uncertainty, we evaluate our results in regressions (1)-(4) in *Table 6.* At first glance, it appears that COVID-19 cases and deaths have, in fact, impacted the level of underpricing and post-IPO stock return volatility. However, only the key independent variable on COVID-19-related deaths shows statistically significant results on one of our dependent variables; underpricing (ref. regression (3)). Considering these results, we can only partly confirm our second hypothesis, as the intensity of the pandemic only seems to affect one of our proxies for information uncertainty.

Evaluating hypothesis three, the significance of government responses as an explanatory variable, we inspect our results from regression (5) and (6) in Table 6. Our findings show that the stringency index measuring COVID-19-related government interventions only has a statistically significant relationship to one of our two dependent variables, namely underpricing. Consequently, hypothesis three can only be partly confirmed, as government interventions only have a statistically significant relationship to one of our two proxies for information uncertainty.

The estimated results from equation *(4. 2)* represented in *Table 6* show that increased COVID-19 intensity prior to the listing of the IPOs, concerning the number of deaths and Stringency, led to greater underpricing. LnDeath and LnStringency are statistically significant, at a 1% and 10% level for the dependent variable underpricing. This is expected as governments acted following the increase in hospitalizations and deaths.

	(1) Underpricing	(2) Volatility	(3) Underpricing	(4) Volatility	(5) Underpricing	(6) Volatility
LnCase	*0.017*	*0.003*				
	(0,89)	*(1.52)*				
LnDeath			*0,152****	*0.003*		
			(2,69)	*(0.48)*		
LnStringency					*0.084**	*0.004*
					(1,76)	*(0.97)*
Greenshoe	*0.069**	*-0.002*	*0.063**	*-0.002*	*0.064**	*-0.002*
	(1.95)	*(-0,68)*	*(1.83)*	*(-0.56)*	*(1.84)*	*(-0.42)*
LnAssets	*0.014*	*-0.002***	*0.013*	*-0.003***	*0.014*	*-0.003***
	(1.26)	*(-2.12)*	*(1,17)*	*(-2,24)*	*(1.30)*	*(-2,29)*
LnMarketCap	*-0.016*	*-0.005****	*-0.014*	*-0.005****	*-0.015*	*-0.005****
	(-1.07)	*(-3.32)*	*(-0,95)*	*(-3.31)*	*(-1.02)*	*(-3.39)*
LnVolume	*0.020***	*0.005****	*0.019***	*0.005****	*0.018***	*0.005****
	(2.44)	*(5.95)*	*(2,29)*	*(5.78)*	*(2.27)*	*(5.86)*
LnFirmAge	*-0.007*	*0.002**	*-0.007*	*0.002**	*-0.002*	*0.002**
	(-0.55)	*(1.71)*	*(-0,55)*	*(1.80)*	*(-0.14)*	*(1.65)*
OfferSize	*-0.073*	*-0.043****	*-0.085*	*-0.043****	*-0.092*	*-0.042****
	(-1,09)	*(-6.34)*	*(-1,28)*	*(-6.26)*	*(-1.37)*	*(-6,06)*
Norway	*-0.016*	*-0.001*	*-0.028*	*-0.001*	*-0,043*	*0,000*
	(-0,55)	*(-0.20)*	*(-0,98)*	*(-0,38)*	*(-1,40)*	*(0,02)*
ROA	*0,001***	*-0,000**	*0.001***	*-0,000*	*0.001***	*-0,000*
	(2,12)	*(-1.76)*	*(2,40)*	*(1,51)*	*(2.56)*	*(-1,63)*
Offer price	*0.000****	*0,000*	*0,000****	*0,000*	*0.000****	*0,000*
	(3.23)	*(1,37)*	*(3,17)*	*(1,25)*	*(3.25)*	*(1,24)*
Tech	*0.013*	*0.001*	*0.015*	*0.001*	*0.023*	*0,001*
	(0.43)	*(0.45)*	*(0.51)*	*(0.41)*	*(0.77)*	*(0,24)*
Intercept	*0.032*	*0.086****	*0.060*	*0.103****	*-0.20*	*0,119****
	(0.12)	*(3.19)*	*(0.25)*	*(4.21)*	*(-0.73)*	*(4,19)*
N	*228*	*228*	*228*	*228*	*228*	*228*
R-squared	*0,140*	*0,394*	*0,165*	*0,389*	*0,159*	*0,391*
Adj. R-squared	*0,096*	*0,363*	*0,122*	*0,357*	*0,116*	*0,359*
F-Statistic	*3.19****	*12.60****	*3.86****	*12.30****	*3,77****	*12.40****
						*Note: *p<0.1; **p<0.05; ***p<0.01*

Table 6: Information uncertainty and COVID-19 Indexes. *The table presents the results of equation (4. 2) using underpricing and volatility as dependent variable proxies for information uncertainty. The key independent variables are the COVID-19 intensity indexes; LnCases, LnDeaths, and the government stringency index; LnStringency. Numbers in parentheses are t-statistics. *, ** and *** indicates statistical significance at a 10%, 5% and 1% level. Age is the IPO issue year minus the founding year. Assets represent a firm's total assets in million. Market Capitalization is a proxy for the firm's value in million. Offer price is the price of the security at offering. Offer Size is the number of shares offered by the issuer in million. ROA (Return on Assets) represents the firm´s profitability. Volume is the trading volume of the 30 first days after offering. LnCase (LnDeath) is the 30-day equally weighted average of number of cases (death cases) in Norway and Sweden before IPO. LnStringency is the 30-day equally weighted average of the index in Norway and Sweden before IPO. Further definitions of all variables can be found in Appendix 1- Table 8.*

Volatility: The COVID-19 intensity indexes and government response index are not statistically significant for either of the regression models for the post-IPO stock return volatility (ref. regression (2), (4), and (6) in *Table 6)*. The estimated results show that the variable's LnCase, LnDeath, and LnStringency are not significant predictors of the variation in the dependent variable, post-IPO stock return volatility. However, the positive coefficients align with our expectations, where a rise in COVID-19 cases, deaths, and more government intervention result in increased volatility. It is also worth noting that LnCases in regression (4) have the highest p-value (p=.1299) of all the key independent variables in the different volatility regressions. Nevertheless, it is essential to mention that the p- values of our key independent variables in the different regressions are not comparable. More importantly, the model seems to capture most of the variations in post-IPO return volatility out of regressions (2), (4), and (6), with the highest R-squared and F-value of 0.394 and 12.60, respectively. Comparing the two regression models (2) and (4) with model (2) in table 6, we see the coefficients of the explanatory variables inhabit roughly the same properties with negligible differences. Further indicating that the dynamics affecting post-IPO stock return volatility are persistent when isolating the pandemic years.

Underpricing: Inspecting the indexes effect on underpricing in the regression models (1), (3), and (6), we notice that LnDeath is statistically significant at a 1% level, LnStringency at the 10% level, whereas LnCases appear to be a non-significant predictor of the variation in underpricing. The positive coefficients of our key independent variables align with our initial assumptions, particularly that a rise in COVID-19 cases, deaths, and government intervention increases the degree of underpricing in IPOs. Similar to regression (2) and (4) discussed above, the coefficients of the explanatory variables in regression (1), (3), and (6) posits similar properties as regression model (1) in *Table 5.* However, when examining the pandemic years in isolation, the coefficient of the variable Greenshoe has decreased and is only significant at a 10% level in comparison to a 1% level. In contrast, the variable ROA is now significant at a 5% level; however, the coefficient still seems to have a negligible effect on the dependent variable. Furthermore, regression model (3) in *Table 6* with LnDeath as the key variable seems to better explain the variation in underpricing with an R-squared of 0,165 and an F-value of 3.87.

5.4 Norway versus Sweden

To determine the effect of COVID-19-related government interventions on underpricing and volatility of Norwegian and Swedish IPOs separately, we run the regressions outlined in *(4.3)* and *(4.4)* with the stringency index as our key independent variable. The estimated results presented in *Table 7* show that an increase in government restrictions prior to the listing of a company is positively associated with our two proxies for information uncertainty. However, our key independent variable only shows a statistically significant relationship with the dependent variable underpricing for IPOs issued in the Norwegian market (ref. regression (1)). Hence, supporting hypothesis 4, that COVID-19-related government responses had a distinct impact in the two countries.

	Norway		Sweden	
	(1) Underpricing	(2) Volatility	(3) Underpricing	(4) Volatility
LnStringency	*0.042 *** *(2.06)*	*0.002* *(1.08)*	*0,011* *(0,29)*	*0.004* *(1.00)*
Greenshoe	*0.038* *(0.78)*	*-0,004* *(-0,91)*	*0,067* *(1.35)*	*-0,000* *(-0,08)*
LnAssets	*0.002* *(0,38)*	*-0.006**** *(-3.56)*	*0,015* *(0.94)*	*-0.001* *(0.27)*
LnMarketCap	*-0.043** *(-1.95)*	*-0.000* *(0.23)*	*-0,038* *(-1,47)*	*-0.010**** *(-3.50)*
LnVolume	*0.025*** *(2.07)*	*0.003*** *(2.34)*	*0.034*** *(2.60)*	*0.006**** *(4.22)*
LnFirmAge	*0,027* *(1.45)*	*0.002* *(1.03)*	*-0.021* *(-1.25)*	*0.002* *(1.31)*
OfferSize	*-0.152** *(-1.92)*	*-0.03**** *(-2,91)*	*-0,191*** *(-2,09)*	*-0.043**** *(-4.37)*
ROA	*0,002** *(1.79)*	*-0,000* *(-1,21)*	*0.001** *(1,88)*	*-0.000* *(1.10)*
Offer price	*0.000**** *(3.27)*	*0,000* *(0,51)*	*0.002*** *(2,49)*	*0.000* *(0.15)*
Tech	*-0,000* *(0.99)*	*0,004* *(0.17)*	*0.028* *(0,66)*	*0.003* *(0,70)*
Intercept	*0.283* *(0.76)*	*0.059* *(0,49)*	*0.328* *(0,78)*	*0.178**** *(4,01)*
N	*85*	*85*	*143*	*143*
R-squared	*0.227*	*0.362*	*0.207*	*0.447*
Adj. R-squared	*0.143*	*0.275*	*0.147*	*0.405*
F-Statistics	*2.33***	*4.14****	*3.45****	*10.7****

*Note: *p<0.1; **p<0.05; ***p<0.01*

Table 7: Information uncertainty and Stringency index (Norway VS. Sweden). *The table presents the result of equations (4.3) and (4.4). We use Underpricing and Volatility as dependent proxies for information uncertainty in Norway and Sweden. The key independent variable is the LnStringency in Norway and Sweden. Numbers in parentheses are t-statistics. *, ** and *** indicates statistical significance at a 10%, 5% and 1% level. Age is the IPO issue year minus the founding year. Assets represent a firm's total assets in million. Market Capitalization is a proxy for the firm's value in million. Offer price is the price of the security at offering. Offer Size is the number of shares offered by the issuer in million. ROA (Return on Assets) represents the firms profitability. Volume is the trading volume of the 30 first days after offering. LnCase (LnDeath) is the 30-day equally-weighted average of number of cases (death cases) in Norway and Sweden before IPO. LnStringency is the 30-day equally-weighted average of the index in Norway and Sweden before IPO. Further definitions of all variables can be found in Appendix 1- Table 8.*

Our results from regression models (1) and (3) indicate that our independent variables for explaining the variation in our dependent variables are similar for IPOs issued in the two markets. The key independent variable is significant on a 5% level in regression (1), indicating that the stringency index significantly affects the level of underpricing. However, it is essential to mention that the regression model has the smallest F-value out of all models, being significant at a 5% level, likely affected by the relatively small dataset. Looking at the coefficients in regression (2) and (4), we notice similar properties, namely that the variables related to the company- or issue size are negatively associated with post-IPO return volatility. Interestingly, we notice that LnAssets and LnMarketCap affect IPOs issued differently in the two markets. LnAssets seems to explain more of the variation in volatility in the Norwegian market, whereas LnMarektCap seems to explain more of the variation in the Swedish market.

5.5 Discussion of results

We have established that COVID-19 significantly affects both underpricing and volatility as proxies for information uncertainty. In other words, the pandemic adversely impacted information uncertainty when studying IPOs issued prior to COVID-19 to IPOs issued post-COVID-19. Moreover, we find statistically significant relations between our proxy underpricing, pandemic-related deaths, and government intervention. Moreover, IPOs issued in the Norwegian market are more sensitive to government responses. However, it is essential to be critical of the analysis results. Thus, this section will critically discuss the overall results and implications for our hypothesis based on the descriptive statistics and regression results.

5.5.1 Effect of market changes

From observation and analysis of the IPO data sample, it is clear that the COVID-19 pandemic severely impacted IPOs in Norway and Sweden. To provide credibility to our results, we account for market movements affecting the financial markets. This is evident in our initial return statistics, where IPOs experienced greater underpricing due to the economic slowdown at the beginning of 2019. The economic downturn resulted from disruptive trade disputes and potential policy mistakes from the Federal Reserve that led to uncertainty in the global financial markets (Lewis, 2019), thereby affecting the stock markets in Norway and Sweden.

However, the severity of events and their effect on underpricing differ, as we saw underpricing of IPOs being even more influenced by the immense market uncertainty created by the pandemic, further supporting our results. Moreover, we saw that post COVID-19 IPOs, initial return stabilized at a higher level after the second quarter of 2020. Arguably, as a result of market participants and people, in general, becoming comfortable and accustomed to a daily life characterized by a pandemic.

The two proxies, underpricing and volatility, are closely related. We see that post-IPO stock return volatility fluctuates in tandem with initial returns (ref. *Figure 5* and *Figure 6*), further supporting our results from *Table 5*. The increase in volatility indicates higher financial risk regarding the IPOs issued post-COVID-19, and it is evident that there is a negative correlation between the volatility measure and the market economy (Esterling, 2022), as quarters with a peak in volatility follow a declining market (e.g., the economic slowdown in 2019). As evident by looking at the 1,5% increase in volatility in 2020, the Norwegian and Swedish economies consequently experienced an average decrease of 3.25% in the gross domestic product (GDP)[4].

5.5.2 Post COVID-19 performance

Our results became more interesting by assessing the three COVID-19-related indexes and their association with our proxies. Where our key independent variable volatility did not yield any significant results. That neither of the COVID-19-related variables is significant for volatility was surprising as stock return volatility is closely related to economic changes. Financial markets were highly affected by the uncertainty following the pandemic, and the World Economy shrank by 4.3% in 2020. Thus, indicating that at least one of the variables should be statistically significant, as in research by Baig & Chen (2022). However, our sample account for two pandemic years, 2020 and 2021, where the second half of 2020 and 2021 are characterized by a more stable period. Following the negative correlation between volatility and financial markets, the stabilization is supported by observing the global economy's swift recovery from the pandemic, with a rise of 5.7% in 2021 (World Bank Group, 2022b). Both Norway and Sweden experienced similar

[4] GDP per capita growth (annual %) is retrieved from https://data.worldbank.org

recovery in 2021, with annual growth of 3.90% and 5.70%. However, it is evident that the Swedish economy is more sensitive to a crisis, with a total accumulation of 8.6% change the year after the pandemic, while Norway experienced an increase of 4.7%. In relation to post-IPO-stock return volatility, one might argue that stock markets of small economies such as Norway and Sweden are more affected by large, global economies like the U.S. Moreover, local policy measures have little impact on stock markets operating on a global scale, where investors from all over the world have the ability to influence them. However, we find results indicating the power of central banks and their essential role as forecasters of macroeconomic developments.

It is clear that Norway and Sweden tackled the pandemic differently regarding responsibility strategy, capacity, and legitimacy. While Sweden primarily opted for voluntary measures, Norway quickly implemented several intrusive closure measures. Resulting in a more controlled situation in Norway compared to Sweden. Even though the Stringency Index indicates slight variation in the strictness in Norway and Sweden, it is crucial to recognize that Sweden presented their measures as voluntary. Further, the perception that the pandemic would not have a severe impact on normal people's lives, "downplaying" the severity of the pandemic compared to Norway. Consequently, the more relaxed approach in Sweden led to them being one of the countries with the highest per-capita mortality in the EU, indicating that we might have seen the inverse by assessing the separated countries' number of deaths. Thus, one could argue that the government's attitude towards the pandemic can explain why government responses are only significant in Norway. One could also argue that the relaxed attitude of Swedish authorities might have spread to spread to the overall population, leading to a situation with less fear and uncertainty.

5.5.3 Concluding remarks

The explanatory variables of significance are not surprising as the number of deaths positively correlates with the strictness of government responses, having a more severe effect than only observing the number of cases. Furthermore, global factors affect stock return volatility more than country-specific pandemic circumstances. Thus, all results can be argued and accounted for, aligning with global and regional financial market changes and previous research.

5.6 Limitations and suggestions for further research

The thesis has several limitations that might be of significance, leaving room for further research. Firstly, it is essential to recognize the limitations of our data sample, where errors can occur due to data being collected through a third party. The concerns and errors of our data could make our results inconsistent, e.g., the frequency of IPO activity and flaws in the COVID-19-related indexes. Further, by researching a larger geographical area, our results would become more reliable regarding more available data. This is especially an issue when investigating the subsamples for post-COVID-19 IPOs in Norway and Sweden. Although our results show several significant results, the subsamples may not be large enough to infer causal effects and relationships. We have chosen the most relevant variables; however, controlling for more variables might result in an estimation showing a "purer" effect of some independent variables—for example, the inclusion of cornerstone investors or underwriter reputation.

Additionally, one might argue that the three COVID-19-related indexes could be of significance when examining only the first pandemic year. In this way, the isolated effect of the pandemic might become more prominent, as the first year of the pandemic was characterized by a more distinct effect on economies, markets, and populations compared to the second year. Moreover, it is essential to recognize that there might be other pandemic-related variables that can provide explanatory power for the increase in volatility and underpricing for IPOs issues post COVID-19. Furthermore, including global pandemic variables and not country-specific measures to see if the correlation between the markets is significant, as the stock market volatility on a global level increased by approximately 5%, whereas the Eurozone, including Norway and Sweden, experienced an increase of 8% (Global Economy, 2022). Hence, leaving room for further research to examine other COVID-19-related variables of significance.

Further, the thesis leaves room for investigating the long-term performance of the IPOs in Norway and Sweden during the pandemic. Previous research from Ritter (1991) finds that IPOs issued in hot markets (i.e., the IPO boom following the COVID-19 pandemic) have poor long-term performance. Therefore, it would be interesting to see if the Norwegian and Swedish IPOs issued during the COVID-19 boom underperform in the long run.

6.0 Conclusion

The thesis investigates the effect of the COVID-19 pandemic on Norwegian and Swedish IPOs. Using underpricing and post-IPO stock return volatility as proxies, this thesis examines how COVID-19 induced information uncertainty. Per previous research on other financial markets, we also found the COVID-19 pandemic adverse impact in the IPO market. The increased uncertainty induced by the pandemic positively correlates with IPO underpricing and volatility.

By analyzing our sample of 305 IPOs and examining the market-adjusted initial return and post-IPO return volatility as a measure of information uncertainty, it is clear that both dependent variables are significantly affected by the COVID-19 pandemic. IPOs post-COVID-19 experienced 7% greater underpricing than those pre-COVID-19. Accordingly, we had an increase of 1.5% post IPO return volatility during the first pandemic year, with a peak of 6.6% volatility in the first quarter of 2020. It is essential to see how the changes in our variables follow the regional and global economic trends, as the underpricing and volatility fluctuate according to market trends. Thus, the stabilization of the greater information uncertainty after the initial shock is closely related to the macroeconomic trends of quick economic recovery in Norway and Sweden.

We find the COVID-19 intensity represented by the number of deaths and Government responses as significant explanatory variables for the increase in underpricing of IPOs issued during the pandemic. The results are not surprising as the number of deaths positively correlates with the strictness of government responses, having a more severe effect than only observing the number of cases. Moreover, our thesis suggests that the Norwegian IPOs initial returns are more sensitive to the government responses than Swedish IPOs. The thesis has hopefully given valuable insight into the mechanisms of the COVID-19 pandemic effect on initial public offerings issued mic in Norway and Sweden, focusing on establishing the relationship between information uncertainty and the COVID-19 intensity. In conclusion, we found that increased pandemic severity, i.e., more deaths and stricter governmental responses, adversely impacted the Norwegian in Swedish IPOs measured by information uncertainty.

7.0 References

Adra, S. (2021). The conventional and informational impacts of monetary policy on the IPO market. *Economics Letters*, *200*, 109751. https://doi.org/10.1016/j.econlet.2021.109751

Aggarwal, R. (2001). Allocation of Initial Public Offerings and Flipping Activity. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.274851

Aksje Norge. (2022, January 20). *Et blikk på Euronext Growth*. https://aksjenorge.no/aktuelt/2022/01/20/eng_jan/

Akyol, A. C., Cooper, T., Meoli, M., & Vismara, S. (2014). Do regulatory changes affect the underpricing of European IPOs? *Journal of Banking & Finance*, *45*, 43–58. https://doi.org/10.1016/j.jbankfin.2014.04.020

Allen, F., & Faulhaber, G. R. (1989). Signalling by underpricing in the IPO market. *Journal of Financial Economics*, *23*(2), 303–323. https://doi.org/10.1016/0304-405x(89)90060-3

Baig, A. S., Butt, H. A., Haroon, O., & Rizvi, S. A. R. (2021). Deaths, panic, lockdowns and US equity markets: The case of COVID-19 pandemic. *Finance Research Letters*, *38*, 101701. https://doi.org/10.1016/j.frl.2020.101701

Baig, A. S., & Chen, M. (2022). Did the COVID-19 pandemic (really) positively impact the IPO Market? An Analysis of information uncertainty. *Finance Research Letters*, *46*, 102372. https://doi.org/10.1016/j.frl.2021.102372

Baker, M. (2020, August 18). *This is how an IPO greenshoe works*. Euromoney. https://www.euromoney.com/article/b1jhjnrn2psn2l/this-is-how-an-ipo-greenshoe-works

Baker, M. P., & Wurgler, J. A. (2007). Investor Sentiment in the Stock Market. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.962706

Barth, M. E., & Kasznik, R. (1999). Share repurchases and intangible assets. *Journal of Accounting and Economics*, *28*(2), 211–241. https://doi.org/10.1016/s0165-4101(99)00020-8

Beatty, R. P., & Ritter, J. R. (1986). Investment banking, reputation, and the underpricing of initial public offerings. *Journal of Financial Economics*, *15*(1–2), 213–232. https://doi.org/10.1016/0304-405x(86)90055-3

Beatty, R. P., & Welch, I. (1996). Issuer Expenses and Legal Liability in Initial Public Offerings. *The Journal of Law and Economics*, *39*(2), 545–602. https://doi.org/10.1086/467359

Benveniste, L. M., & Spindt, P. A. (1989). How investment bankers determine the offer price and allocation of new issues. *Journal of Financial Economics*, *24*(2), 343–361. https://doi.org/10.1016/0304-405x(89)90051-2

Bergström, C., Nilsson, D., & Wahlberg, M. (2006). Underpricing and Long-Run Performance Patterns of European Private-Equity-Backed and Non-Private-Equity-Backed IPOs. *The Journal of Private Equity*, *9*(4), 16–47. https://doi.org/10.3905/jpe.2006.650457

Booth, J. R., & Chua, L. (1996). Ownership dispersion, costly information, and IPO underpricing. *Journal of Financial Economics*, *41*(2), 291–310. https://doi.org/10.1016/0304-405x(95)00862-9

Chen, H. C., & Ritter, J. R. (2000). The Seven Percent Solution. *The Journal of Finance*, *55*(3), 1105–1131. https://doi.org/10.1111/0022-1082.00242

Corporate Finance Institute. (2020, May 7). *Adjusted Closing Price*. https://corporatefinanceinstitute.com/resources/knowledge/trading-investing/adjusted-closing-price/

Corporate Finance Institute. (2022, May 7). *R-Squared*. https://corporatefinanceinstitute.com/resources/knowledge/other/r-squared/

Esterling, E. (2022, January). *Volatility in Perspective*. Crestmont Research. https://www.crestmontresearch.com/docs/Stock-Volatility-Perspective.pdf

Euronext Group. (2022, January 1). *How to list on Oslo Børs | euronext.com*. Euronext. https://www.euronext.com/en/list-products/bonds/how-list-oslo-bors

Global economy. (2022). *Global economy, world economy*. TheGlobalEconomy.Com. https://www.theglobaleconomy.com

Hanley, K. W., & Wilhelm, W. J. (1995). Evidence on the strategic allocation of initial public offerings. *Journal of Financial Economics*, *37*(2), 239–257. https://doi.org/10.1016/0304-405x(94)00797-5

He, P. (2007). A Theory of IPO Waves. *Review of Financial Studies*, *20*(4), 983–1020. https://doi.org/10.1093/revfin/hhm004

Hovland, K. M. (2021, May 10). *Legger frem revidert budsjett tirsdag: – God tro på at vi skal få fart på Norge*. e24. https://e24.no/norsk-oekonomi/i/kR71Bj/legger-frem-revidert-budsjett-tirsdag-god-tro-paa-at-vi-skal-faa-fart-paa-norge

Ibbotson, R. G., & Jaffe, J. F. (1975). “HOT ISSUE” MARKETS. *The Journal of Finance*, *30*(4), 1027–1042. https://doi.org/10.1111/j.1540-6261.1975.tb01019.x

Ibbotson, R. G., Sindelar, J. L., & Ritter, J. R. (1988). INITIAL PUBLIC OFFERINGS. *Journal of Applied Corporate Finance*, *1*(2), 37–45. https://doi.org/10.1111/j.1745-6622.1988.tb00164.x

Ibbotson, R. G., Sindelar, J. L., & Ritter, J. R. (1994). THE MARKET’S PROBLEMS WITH THE PRICING OF INITIAL PUBLIC OFFERINGS. *Journal of Applied Corporate Finance*, *7*(1), 66–74. https://doi.org/10.1111/j.1745-6622.1994.tb00395.x

Jarociński, M., & Karadi, P. (2020). Deconstructing Monetary Policy Surprises—The Role of Information Shocks. *American Economic Journal: Macroeconomics*, *12*(2), 1–43. https://doi.org/10.1257/mac.20180090

Jenkinson, T., & Ljungqvist, A. (2001). *Going Public: The Theory and Evidence on How Companies Raise Equity Finance* (2nd ed.). Oxford University Press.

Johannessen, E. M. B. H. (2021, July 9). *Venter at noteringsrushet vil fortsette: – Aldri opplevd et så stort trykk*. Www.Dn.No. https://www.dn.no/bors/borsnoteringer/euronext-growth/wiersholm/venter-at-noteringsrushet-vil-fortsette-aldri-opplevd-et-sa-stort-trykk/2-1-1037862?v=6624

Kahneman, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, *47*(2), 263. https://doi.org/10.2307/1914185

Kenton, W. K. (2019, April 3). *What Is the Industry Classification Benchmark (ICB)?* Investopedia. https://www.investopedia.com/terms/i/industry-classification-benchmark.asp

Kuswanto, R. (2021). IPO Stock Performance amidst the COVID-19 Pandemic: Has It been Undervalued? *Jurnal Dinamika Akuntansi Dan Bisnis*, *8*(1). https://doi.org/10.24815/jdab.v8i1.19830

Lewis, A. (2019, December 31). *The stock market boomed in 2019. Here’s how it happened*. CNBC. https://www.cnbc.com/2019/12/31/the-stock-market-boomed-in-2019-heres-how-it-happened.html

Ljungqvist, A. (2007). IPO Underpricing. In B. Espen Eckbo (Ed.), *Handbook of Corporate Finance: Empirical Corporate Finance* (1st ed., Vol. 1, pp. 375–422). Elsevier/North-Holland Handbooks in Finance Series.

Ljungqvist, A., Nanda, V., & Singh, R. (2006). Hot Markets, Investor Sentiment, and IPO Pricing*. *The Journal of Business*, *79*(4), 1667–1702. https://doi.org/10.1086/503644

Loughran, T., & Ritter, J. R. (2002). Why Don't Issuers Get Upset About Leaving Money on the Table in IPOs? *Review of Financial Studies*, *15*(2), 413–444. https://doi.org/10.1093/rfs/15.2.413

Loughran, T., & Ritter, J. R. (2004). Why Has IPO Underpricing Changed Over Time? *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.331780

Loughran, T., Ritter, J. R., & Rydqvist, K. (1994). Initial public offerings: International insights. *Pacific-Basin Finance Journal*, *2*(2–3), 165–199. https://doi.org/10.1016/0927-538x(94)90016-7

Lowry, M. (2003). Why does IPO volume fluctuate so much? *Journal of Financial Economics*, *67*(1), 3–40. https://doi.org/10.1016/s0304-405x(02)00230-1

Lowry, M., Officer, M. S., & Schwert, G. W. (2010). The Variability of IPO Initial Returns. *The Journal of Finance*, *65*(2), 425–465. https://doi.org/10.1111/j.1540-6261.2009.01540.x

Lu, X., & White, H. (2014). Robustness checks and robustness tests in applied economics. *Journal of Econometrics*, *178*, 194–206. https://doi.org/10.1016/j.jeconom.2013.08.016

Macrotrends. (2022). *Norway Unemployment Rate 1991–2022*. https://www.macrotrends.net/countries/NOR/norway/unemployment-rate

Mazumder, S., & Saha, P. (2021). COVID-19: Fear of Pandemic and Short-Term IPO Performance. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3784013

Megginson, W. L., & Weiss, K. A. (1991). Venture Capitalist Certification in Initial Public Offerings. *The Journal of Finance*, *46*(3), 879–903. https://doi.org/10.1111/j.1540-6261.1991.tb03770.x

Miller, R. E., & Reilly, F. K. (1987). An Examination of Mispricing, Returns, and Uncertainty for Initial Public Offerings. *Financial Management*, *16*(2), 33. https://doi.org/10.2307/3666001

Moore, C. B., Bell, R. G., Filatotchev, I., & Rasheed, A. A. (2012). Foreign IPO capital market choice: Understanding the institutional fit of corporate governance. *Strategic Management Journal*, *33*(8), 914–937. https://doi.org/10.1002/smj.1953

Nasdaq. (n.d.). *Nasdaq First North Growth Market*. https://www.nasdaq.com/solutions/nasdaq-first-north-growth-market

Norges Bank. (n.d.). *Norges Bank*. https://www.norges-bank.no

Ritchie, H. (2020, March 5). *Coronavirus Pandemic (COVID-19)*. Our World in Data. https://ourworldindata.org/coronavirus

Ritter, J. R. (1984). The “Hot Issue” Market of 1980. *The Journal of Business*, *57*(2), 215. https://doi.org/10.1086/296260

Ritter, J. R. (2022, June 6). *IPO Data*. Jay R. Ritter. https://site.warrington.ufl.edu/ritter/ipo-data/

Rock, K. (1986). Why new issues are underpriced. *Journal of Financial Economics*, *15*(1–2), 187–212. https://doi.org/10.1016/0304-405x(86)90054-1

Rolander, N., & Wilen, A. (2020, January 31). *Bloomberg - Sweden Reports First Case of Confirmed Coronavirus*. Bloomberg. https://www.bloomberg.com/tosv2.html?vid=&uuid=ac0343d8-f233-11ec-a0f7-52634d414e74&url=L25ld3MvYXJ0aWNsZXMvMjAyMC0wMS0zMS9zd2VkZW4tcmVwb3J0cy1maXJzdC1jYXNlLW9mLWNvbmZpcm1lZC1jb3JvbmF2aXJ1cw==

Roser, M. R. (2021, December 24). *What is the COVID-19 Stringency Index?* Our World in Data. https://ourworldindata.org/metrics-explained-covid19-stringency-index

Smith, T. S. (2022, February 17). *Greenshoe Option*. Investopedia. https://www.investopedia.com/terms/g/greenshoe.asp

Spotlight. (n.d.). *The listing process | Spotlight*. https://spotlightstockmarket.com/en/join-spotlight/the-listing-process

Statista. (2022, May 5). *Gross domestic product (GDP) per capita at current prices in Norway 2011–2021*. https://www.statista.com/statistics/587171/gross-domestic-product-gdp-per-capita-in-norway/

Sveriges Riksbank. (n.d.). *Startsida*. https://www.riksbank.se

The world bank. (2022). *GDP growth (annual %) - Sweden, Norway | Data*. The World Bank, Data. https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=SE-NO

Treloar, S. (2020, February 27). *Bloomberg - Norway Confirms Its First Case of Coronavirus*. Bloomberg. https://www.bloomberg.com/tosv2.html?vid=&uuid=05b958c0-f234-11ec-8c4f-69794a75464c&url=L25ld3MvYXJ0aWNsZXMvMjAyMC0wMi0yNi9ub3J3YXktY29uZmlybXMtaXRzLWZpcnN0LWNhc2Utb2YtY29yb25hdmlydXM=

United Nations. (2021, January 25). *World Economic Situation and Prospects 2021*. https://www.un.org/en/world-economic-situation-and-prospects-2021

University of Oxford. (2020, March 18). *COVID-19 Government Response Tracker*. Blavatnik School of Government. https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker

Wagner, H. (2022, May 15). *Why Volatility is Important for Investors*. Investopedia. https://www.investopedia.com/articles/financial-theory/08/volatility.asp

Wass, S. W., & Ahmad, R. A. (2021, September 30). *Nordic IPO boom to continue into 2022 as investment banks fight for market share*. S&P Global Market Intelligence. https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/nordic-ipo-boom-to-continue-into-2022-as-investment-banks-fight-for-market-share-66767801

Welch, I. (1989). Seasoned Offerings, Imitation Costs, and the Underpricing of Initial Public Offerings. *The Journal of Finance*, *44*(2), 421–449. https://doi.org/10.1111/j.1540-6261.1989.tb05064.x

Wooldridge, J. M. (2019). *Introductory Econometrics: A Modern Approach (MindTap Course List)* (7th ed.). Cengage Learning.

World Bank Group. (2022, January 14). *COVID-19 to Plunge Global Economy into Worst Recession since World War II*. World Bank.

https://www.worldbank.org/en/news/press-release/2020/06/08/covid-19-to-plunge-global-economy-into-worst-recession-since-world-war-ii

World Health Organization. (2022, March 28). *Timeline: WHO's COVID-19 response*. Timeline: WHO’s COVID-19 Response. https://www.who.int/emergencies/diseases/novel-coronavirus-2019/interactive-timeline

Yung, C., Colak, G., & Wang, W. (2008). Cycles in the IPO market☆. *Journal of Financial Economics*, *89*(1), 192–208. https://doi.org/10.1016/j.jfineco.2007.06.007

Zaremba, A., Kizys, R., Aharon, D. Y., & Demir, E. (2020). Infected Markets: Novel Coronavirus, Government Interventions, and Stock Return Volatility around the Globe. *Finance Research Letters*, *35*, 101597. https://doi.org/10.1016/j.frl.2020.101597

Zhou, L. J., & Sadeghi, M. (2019). The impact of innovation on IPO short-term performance – Evidence from the Chinese markets. *Pacific-Basin Finance Journal*, *53*, 208–235. https://doi.org/10.1016/j.pacfin.2018.10.010

Appendix

Appendix 1:Variable definition

Variable	Definition
Covid	*Indicator variable equal 1 if the IPO is issued after March 2020, and zero otherwise.*
CP	*Closing price at a given trading day t.*
Greenshoe	*Indicator variable equal 1 if the IPO is an over-allotment option, and zero otherwise.*
Assets	*The firms' total assets in millions in the year before the IPO*
LnCases	*Natural log of an equally weighted average of number of cases in Norway and Sweden for a 30-day average before IPO day.*
LnDeaths	*Natural log of an equally weighted average of number of deaths in Norway and Sweden for a 30-day average before IPO day.*
ROA	*Return on Assets, as a proxy for a firms' profitability given their total assets*
LnFirmAge	*Natural log of the firm age plus one, being the founding year subtracted from the IPO year.*
LnMarketCap	*Natural log of the company value, found by multiplying outstanding shares and offer price.*
OfferSize	*Number of shares offered by the issuer in million.*
Volume	*Trading volume of the 30 first days after offering.*
LnStringency	*Natural log of an equally weighted average of number of deaths in Norway and Sweden for a 30-day average before IPO day.*
OP	*Price of the IPO at offer day*
Underpricing	*Return from offer price to first closing price, adjusted for market returns.*
Volatility	*Standard deviation of the first 30-day returns after IPO day. Excluding the initial return.*

Table 8: Variable definition. *The table provides description of all variables that will be used in our thesis.*

Appendix 2: Variance Inflation Factor (VIF)

Variable	VIF
lnCap	3.8286
lnAge	1.2232
lnAssets	3.1581
lnVolume	1.5845
Offerprice	1.0320
Offersize	1.1340
ROA	1.2857
Covid	1.1813
GSO	1.7635
Tech	1.0663
Norway	1.3190
Mean VIF	1.4747

Table 9: Variance Inflation Factor (VIF). *Indicating a moderate correlation between all variables as all values are between 1 and 5. Age is the IPO issue year minus the founding year. Assets represents a firm's total assets in million. Market Capitalization is a proxy for the firm's value in million. Offer price is the price of the security at offering. Offer Size is the number of shares offered by the issuer in million. ROA (Return on Assets) represents the firms profitability. Volume is the trading volume of the 30 first day after offering. LnCase (LnDeath) is the 30-day equally weighted average of number of cases (death cases) in Norway and Sweden before IPO. LnStringency is the 30-day equally weighted average of the index in Norway and Sweden before IPO.*

Appendix 3: Distribution of returns

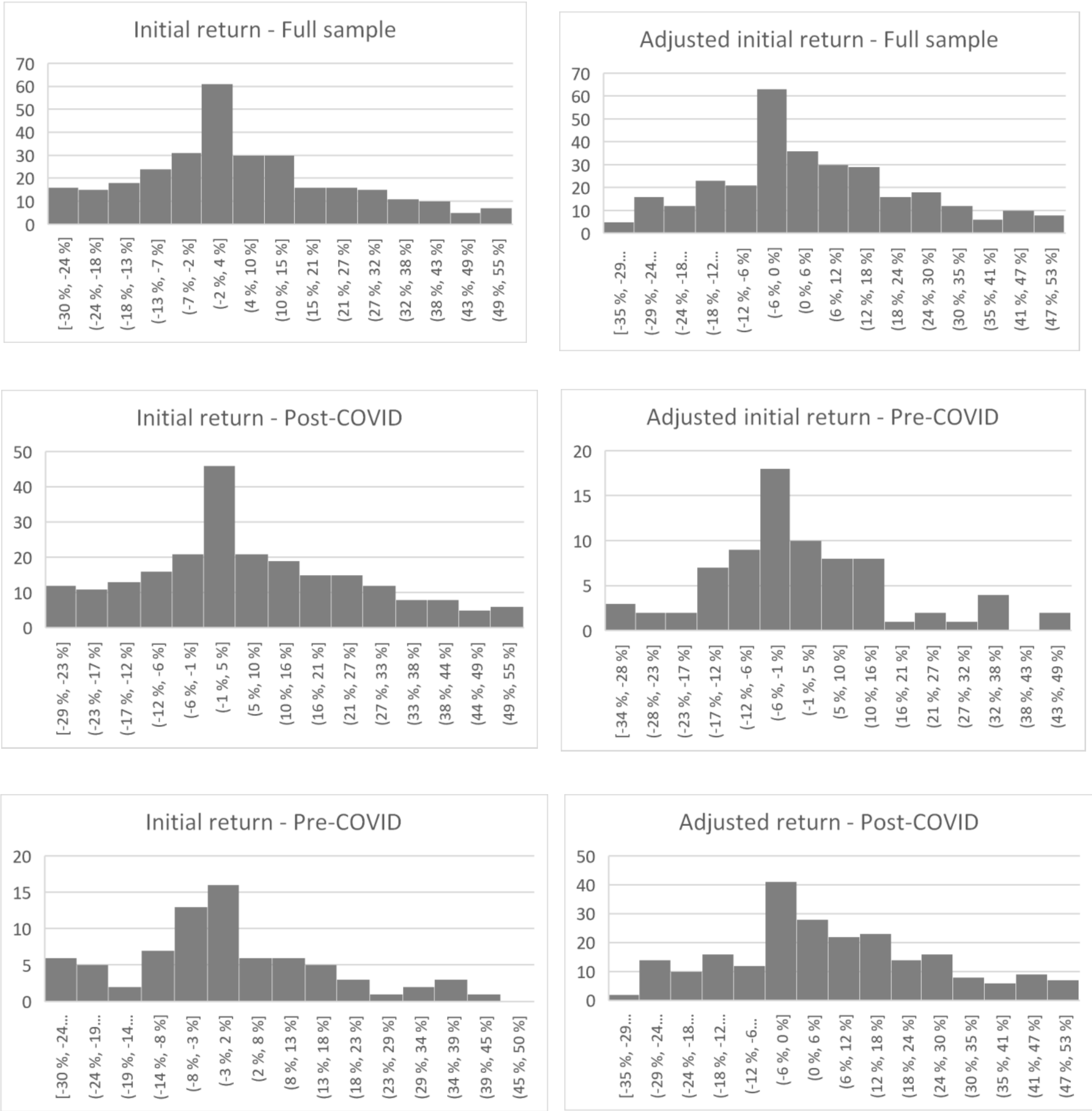

Figure 9: Distribution of returns. *The figure illustrates the distribution of Initial Return and Adjusted Initial Return with number of IPOs (represented on the y-axis) and the frequency of IPOs in the different percentage intervals (represented on the x-axis). The sample is divided into three different periods (1) the full period, with all 305 observations (2) all 77 IPOs issued pre COVID-19, before March 2020. (3) All 228 IPOs issued during COVID-19, after March 2020.*