Long-term IPO Performance in the United States Stock Market during Covid-19 and its Defining Financial Factors

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Abstract

The Initial Public Offering (IPO) is a critical milestone for companies, providing a significant opportunity to obtain essential capital for growth and market expansion. Despite the annual inflow of companies seeking investors through IPO procedure, the outbreak of the Covid-19 pandemic in early 2020 disrupted the stability of the IPO market, leading many firms to postpone their planned IPOs. However, the latter half of 2020 witnessed an unprecedented IPO boom, the most substantial in three decades.

This thesis delves into the examination of the long-term IPO performance of 150 companies that made their public debut in 2020 on the NYSE, NASDAQ, and NYSEAMERICAN U.S. stock exchanges. Employing the Buy-and-hold abnormal return methodology and comparing the findings with market indexes such as S&P 500, NASDAQ, and a sample of matched by size and industry companies, the researcher analyzes the post-IPO market dynamics, the researcher was able to conclude the significant existence of both short-term measured over 12 months and long-term measured over 36 months IPO underperformance.

For a more detailed search for the causes of this effect multiple linier regression (MLR) with financial influencing factors such as ROA and Total Sales 2 years before the company's IPO is integrated in this thesis, in which no significance was found. Despite the absence of statistically significant correlation, this study contributes to a deeper understanding of the complex relationship between financial metrics and post-IPO outcomes. The implications of these results are far-reaching, urging all stakeholders involved in the IPO process to carefully evaluate and adapt strategies in light of the complex and evolving dynamics observed in the market.

Keywords/tags (subjects)

Long-term performance, IPO, U.S. market, Covid-19, multiple linier regression, buy-and-hold-abnormal returns, financial performance, S&P 500, NASDAQ, matched sample of companies

Miscellaneous (Confidential information)

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1 Introduction

The introductory section introduces the reader to the motivation and theory chosen for the topic and provides the further direction of the paper's content, and precedes the comprehensive literature review and practical analysis together with the research findings.

1.1 Research Background

IPO, which stands for "Initial Public Offering", refers to the first issue of securities such as debentures, bonds, shares of companies when they go from wholly privately owned to the public market. This process has a number of advantages for the company, thus opening up the possibility of significant new financial and investment cash flows, which in turn increases the capital and the amount of money available for business activities. However, despite the apparent attractiveness of the issuer should consider all the details as well as the risks involved in the offering. Several parties are involved in the IPO process, in addition to the issuer, the company wishing to trade publicly, there is an underwriter or investment bank providing assistance services, auditors, lawyers, stock exchange representatives and investors, thus many companies leave a long time to prepare and effective communication between all these participants. (Ritter, 1998). If a large company decides to undergo the IPO process, its primary target is the U.S. stock market because the U.S. initial public offering IPO market is highly attractive, accounting for 30% of the global IPO market and 48% of all global IPO proceeds, this widespread appeal makes it the preferred choice for many companies, with the opportunity to raise significant capital being the primary motivation (Statista, n.d.).

In relation to IPOs, there are also some phenomena and anomalies that have been widely mentioned in the academic literature consisting of initial underpricing and long-term underperformance. Indicating imperfect market efficiency and consisting of the difference between the price at the end of the first trading day after the IPO and the offer price and the tendency to lower market returns for recently listed IPO firms compared to benchmarks, namely indexes or established market firms, respectively (Perera, 2015). In this case, long-term underperformance is a less studied phenomenon which seems to still present in the market, for instance Ritter (2023) indicates -18.7% market adjusted returns for IPO firms from 1980-2023, so that significantly underperforming the market. In this case there are many theories trying to explain this fact, one of them

concerns the hot and cold issue market, in which instance the recent pandemic Covid -19 becomes particularly intriguing, as despite the financial crisis and the downturn in the first half of the year was characterized by a sharp rise in the second half and the biggest number of new IPOs in the last 20 years since the "Internet boom" in the 1990s (Baig & Chen, 2022).

1.2 Research Motivation

The author believes that this work will bring a new insight for investors looking to participate in IPO and find out about potential risks and opportunities it has as a type of investment. Investors both individual and institutional are willing to know as much as possible of information in regard to the planned investment to understand the true value and the mechanisms that can change the value of an asset in the future. Therefore, this thesis can have a useful information needed to make a successful investment and minimize the risks of depreciation of a stock.

Especially important topic of the underperformance phenomena is presented for the privately owned companies considering to conduct an IPO in the future and are the subject to the direct risk of losing money. This also refers to the other parties involved in arranging IPO process such as underwriters, investment bankers, independent auditors. There are particular theories of what causes underperformance which will be reviewed and given assessment in this work, therefore giving a chance to take into account by the firm management on the planning stage and weighing the options of alternatives to IPO or taking measures and deep analysis for successful initial offering and sustain decent aftermarket performance

The author also hopes to provide a new outlook on the phenomenon of long-term IPO performance for the academic world that will add to the already existing broad discussion. It may become the basis for future in-depth research and testing of additional theories based on this paper. Although this topic and phenomenon has been well established for a long time, there remains a part of interest due to new events and new economic realities, such as the recent Covid-19 virus, which has significantly affected the financial market, but has not yet been adequately investigated, so this thesis can be an important academic component to understand the effect of the crisis on the U.S. IPO market.

This thesis is highly relevant for the author, as it is a particular interest in connection with the personal expansion of knowledge about investment and IPO, the author during the work on this paper plans to understand this topic in depth and apply the knowledge and theories gained and be able to evaluate the upcoming investment with the help of insights collected during the research.

1.3 Research questions

The author by means of research questions attempts to learn more about the specifics of IPOs in the long term, as well as additional information related to the listing process, plans to find existing theories to explain the phenomenon, evaluate empirical evidence and factors potentially affecting it. It is also of particular importance to provide an extensive explanation of the possible effects of Covid 19 on financial processes and the IPO process. In doing so, the "Literature Review" section will endeavor to answer the subsequent research questions:

1 What is the long-term performance of initial public offerings (IPOs) in the US stock market?

2 What are the main financial factors that determine the long-term performance of initial public offerings (IPOs) in the US stock market during Covid-19?

2   Literature review

In the thesis's literature review section, the writer examines the existing research conducted on the chosen subject. This involves summarizing the main theories, ideas, methods, and findings from previous studies. The goal is to understand what has been explored and what gaps still exist in the current understanding. The literature review helps establish the basis for this research by forming the theoretical framework and identifying the specific areas where more investigation is needed. This, in turn, guides the research questions and the overall approach taken in the thesis.

2.1   Motivation to conduct IPO

Privately owned companies usually face a choice when they are about to initiate an IPO, this includes considering the prospective implications of entering a new market and being open to investment and the costs associated with this important process. In this chapter considered a closer look at the incentives and risks that influence a company's strategic decision

One of the main advantages that drives companies to conduct IPO is a quick access to external funding from great number of investors and use gained liquidity next in order to finance new projects, infrastructure and expand its operations (Nasdaq, 2016). It also provides an access to new financial options, which may be necessary as an alternative to bank debt, particularly important when the terms of a partnership with a bank carry uncomfortable conditions in the form of high interest rates or credit rating downgrades (Pagano et al., 1995). Hence, after the IPO it is reasonable to expect a reduction in the debt burden and new capital inflows from both institutional and retail investors with the potential to increase in the long term. In the research conducted by Pešterac (2020), it is noted that companies which avoid intense competition and refrain from going public through an IPO may expose themselves to the possibility of being acquired by more established market participants. Additionally, the study suggests that more successful companies are more inclined to choose the option of conducting an IPO (Pešterac 2020).

In addition, post-IPO environment creates a precondition for increased bargaining power, as the Raghuram (1992) claim that publicly traded companies can distribute confidential information to a wider range of investors, therefore limiting the bank's ability to charge a premium for exclusive access to sensitive information and potentially leading to lower lending rates.

Ellingsen & Rydqvist (1997) emphasizes the increase in company's prestige and publicity as a benefit of IPO. This is also supported by the fact that US stock exchanges are the largest in the world and the attention of most investors looking for new sources of investment is focused on new IPOs, thus it can serve as a channel for promotion without additional costs for image enhancement. Pagano et al. (1995) add to the same point and claim that " most investors hold portfolios which contain only a small fraction of the existing securities, often because they simply ignore that a certain company exists". However, the same publicity might bring some of the hazards such as public judgement and high attention to the financial state of the company and its reputacy (Pešterac, 2020)

While there are significant benefits for the companies to go public, number of risk factors may be considered as well. For example, the main fear that the company's management may have is the possibility of the IPO not going through successfully, which implies a number of factors that can go wrong, due to the uncertainty about information about the new company this makes it a difficult task to evaluate it, as well as the size of the offer, which directly correlates with investor interest yet cannot be calculated with infallible accuracy (Zhang et al., 2022)

IPO litigation risk is mostly related to the U.S. market, the essence of which is a possible lawsuit filed by an investor against a company that has made an IPO, yet failed to meet market performance expectations anticipated by the involved parties. Furthermore, because the company discloses previously confidential information as mandated by the national regulator, various opportunities for legal condemnation become available. Nonprofits and high-value companies are the primary targets for prosecution, with the main causes of litigation being securities class actions, stock-drop lawsuits, and patent lawsuits. (Zhang et al., 2022).

Companies are also exposed to the risk linked with the costs of the IPO process, such as commissions to the investment bank, registration, information costs (Pešterac, 2020). A more detailed analysis also points to the costs in regard to finding new staff for positions associated with publicly traded companies, such as reporting and finance, human resources and investor relations. Administrative costs associated with reporting to the SEC regulator include quarterly reports, annual reports, proxy materials, transfer agents and investor publications (PwC Deals, 2017).

Companies are required to disclose corporate information if they are publicly traded, thus it can be a source of competitive risk when future R&D projects and their costs or new business and marketing strategies are disclosed (Pagano et al. 1995).

Firms opting for an IPO are subject to the administrative costs associated with the process of going public and trading on the stock exchange. These costs include annual accounting statements, audit fees, certificates, and stock exchange fees. Moreover, it is worth noting that also a significant effect on the top of the whole has an initial underpricing, the extent of which also represents significant risks (Pagano et al. 1995). Moreover, the peculiarity of these costs is that they represent a particular danger for small companies due to the non-proportionality of the costs that give large companies an advantage (Pagano et al. 1995).

2.2 IPO Process and Regulation In the U.S. Market

An Initial Public Offering process is a crucial moment for a company that defines its future prospects and the way it will operate in the market. One should consider that an IPO is a long and effort-consuming procedure with substantial risks associated with it, however many companies at some point decide to become publicly traded. Once a company goes public, it has to face new changes in every aspect of corporate life and adapt quickly. The importance of the right approach and attention to detail, such as compliance with the regulatory requirements during the IPO is viewed to be the key to quality sustaining the growth of the company in future trading on the stock exchange (PwC Deals, 2017). Therefore, it is important to review in detail each step of the average IPO process with regard to the practice in the United States to develop an understanding of how the companies go through this process in order to get a chance of promoting themselves on the stock exchange.

Firstly, any company wishing to conduct an IPO is in the planning stage, which involves evaluating the opportunities that an IPO offers and comparing it to other options for raising capital. Once a positive decision has been made, the selection of an underwriter who conducts the pricing procedure and additional assistance in preparation for the first trading day begins (Vipond, n.d.). Many investment banks are striving to conduct a successful IPO, taking care of their image, thus carefully evaluating the future candidate, where the criteria such as a large market, steady revenue growth, a unique business model, a successful and potential product, a management team that is ready for

publicity and a high level of control over regulatory compliance are given priority (PwC Deals, 2017)

Further, there are several agreements available for working with the underwriter, ranging from a Firm Commitment allowing the purchase of all shares in the company for resale at the time of the IPO to investors, where guarantees are agreed on a minimum amount of money to be raised during the sale, a Best Efforts Agreement where the lead bank is already acting on behalf of the company with no specific amount to be raised and an All or None Agreement where the parties agree to a full sale on behalf of the underwriter of every last share or all funds will be returned to investors (Vipond, n.d.).

Secondly, after a meeting of a working group consisting of the top management of the company, independent auditors, the depositary bank committee prepares a registration statement for the SEC, where sections of the registration statement are filled out, financial information is reviewed and disclosures, once the general approval of the entire working group is manifested the document is filed with the SEC. In turn, the SEC adds changes and expressions to be considered and the company finalizes the original version of the statement ("Listing in the US", 2017). The registration statement in particular includes a Prospectus, a document of particular interest to investors that provides insight into the financial condition and history of the company prior to the IPO, and Private filings that solely intended for the SEC (Vipond, n.d.).

Additionally, a Red Herring document is created for presentation to investors that contains an initial prospectus that provides additional details about the company preparing for an IPO, but lacks an effective date which defined as the date of actual sale available to the investors and offer price. (Vipond, n.d.).

Lastly, after the red herring document is created, parties such as the issuing firm, underwriter representatives and investment bank participants meet with major institutional investors to showcase the upcoming IPO and generate interest in their direction, as well as to identify potential demand ("Listing in the US", 2017)

To conclude the process, the pricing step is arranged when the effective date, offer price, and the number of total outstanding shares that are going to be issued are precisely known in advance. (Vipond, n.d.). The latest version of the prospectus is sent to the SEC with the latest corrections and the underwriting agreement between the investment bank and the issuer is signed. Then, the offering can be considered as started. When the first trading day of the new IPO is opened, it usually takes a few days to complete the process, which can be indicated by the closing trading day when the fee held by the issuing company and the capital raised from the underwriter are exchanged. ("Listing in the US", 2017)

2.3 Initial Underpricing

Initial underpricing is another IPO-related anomaly that has been widely researched over the last decade, thus presenting theories to explain its occurrence. Underpricing or first-day return is the difference between the discount at which the company went to market and what the market was pricing at the end of the first trading day, or the capital that the company missed out on as a result of the difference in price. Following formula shows how initial underpricing is estimated:

$$First-Day\ Returns = \frac{Closing\ Price - Offer\ Price}{Offer\ Price}$$

The main theories related to the occurrence of this effect are divided into the categories of asymmetric information, institutional, control and behavioral. Summarizing each of the theories, asymmetric information stands out in the form of a more informed participant in the company's entry into the market, which shifts information and thus creates underpricing. In turn institutional are based on the components of litigation, price stabilization by undewriter after the start of trading and taxes. Control theory, the idea of which is to maintain control in the company by underpricing. And concluding with the behavioral theory explaining the level of underpricing by irrational investors willing to bid more than the fair price of the company (Ljungqvist, 2007).

Many studies have captured cases of initial underpricing, which appears to be a broad and well-discussed phenomenon. For instance, Loughran and McDonald (2017) found first-day returns in a sample of 1,887 companies from 1997-2010 in the U.S. market with an offer price below $5

averaged 34.8% throughout the study period, while during the Internet boom of 1999-2000, high-lighted by increased IPO activity, initial market returns were 71.3%, in 1997-1998 and 2001-2010 15.1%. Another study of Campbell et al. (2008) suggests that a sample of 2100 U.S. IPO firms which conducted initial offering between 1970-2004 90% of companies have positive initial market return while 50% are overvalued

Also, cross-country studies on this topic indicate that this effect occurs in most global markets, varying in results and being influenced by the specifics of each country's regulation. So, Banerjee et al. (2010) studied the IPO market and the first day of initial return after the IPO between 36 countries from 2000 -2006, with results the lowest in Norway 4.33% and the highest in China 57.14%, it was found that the main reasons worsening the effect of underpricing can be attributed to four characteristics of countries such as greater distance in the asymmetry of information, lower level of home-country bias from investors, less effective system of contractual obligations fulfillment and easier access to the judicial system.

2.4 Market Efficiency Theory

In relation to one of the potential causes for underperformance of IPOs, it is essential to mention the efficient market theory proposed in one of the most fundamental works of the financial world Fama (1970), which claimed that stock prices are perfectly fair and fully reflected by publicly available information, therefore it leaves no chance for underpricing and making any investing strategy to beat the market pointless. Regarding this theory, certain questions arise, which are to examine how quickly information is integrated into the stock price and what is meant by relevant and irrelevant information in this case. To clarify these issues, Fama (1970) proposed to categorize into three types of efficient market forms

Weak-form efficiency results in the inability of investors to receive a premium by taking into account the past performance of a company's stock, as this information is considered irrelevant and has no impact on the behavior of the stock at the moment. Future price movements also have no relationship with the past performance hence making technical analysis completely unhelpful

Semi-strong form efficiency describes a type of market where the stock price incorporates all the public information that is available about the company and its industry. This includes not only the

past price history, but also other sources of public information, such as corporate announcements, company financial statements, industry reports, and macroeconomic indicators. In a semi-strong efficient market, investors cannot gain any advantage by using fundamental analysis, which is based on evaluating the intrinsic value of the company based on its financial performance and prospects. In a semi-strong efficient market, the stock price adjusts quickly and accurately to any new public information that is released, leaving no opportunity for investors to exploit any inefficiencies.

Strong form efficiency introduces the market where the stock price accurately represents all important information about the firm, both public and private. This implies that insider information, which is held by a small number of individuals who have access to confidential and privileged information about the company, such as executives, analysts, and experts, is also already incorporated in the stock price. In a strong form efficient market, investors cannot gain any advantage by using technical or fundamental analysis, as there are no information asymmetries or hidden opportunities in the market. In a strong form efficient market, the stock price represents the true value of the company at any given time (Pilbeam, 2005).

Although any of the mentioned market form implies that IPOs should not exhibit any abnormal returns in the long run, as the market price should reflect all available information and adjust quickly to any new information. However, many empirical studies have challenged this theory by documenting a persistent and puzzling phenomenon of long-run underperformance of IPOs. This phenomenon means that IPOs tend to have lower returns than comparable firms or market indexes over a period of several years after going public.

Researchers often focus on this theory in the context of initial underpricing of a recently listed IPO, where initial underpricing is the difference between the offer price at which trading began and the market price at which the first trading day ended. Lowrya and Schwertb (2004) investigated whether the IPO pricing process is efficient by determining if the public information known to both underwriters and issuers is incorporated into the offer price, making initial underpricing a consequence of another financial mechanism than market imperfections, and found that despite the fact that underwriters do not take into account a certain amount of public information, the pricing process can be called efficient. In turn, Demers and Joos (2007) with the widely documented initial

underpricing phenomena questioned the reason why the companies usually neglect large losses that they experience when investors obtain cheaper offer price than the market price by the end of the day and not having afterwards disputes with the underwriter undertaking the IPO, where one of the most apparent reason is paying underwriter an indirect commission in the cost of the issuer in order to create a demand among investors who will be willing to deliver specific benefits in exchange, which also does not reject the efficient market theory.

2.5 Underperformance

One of the specific and widely discussed debates beyond the initial underpricing puzzle concerning the topic of IPOs is the phenomenon of long-term underperformance, which can be explained as newly issued companies tend to have lower long-term market returns compared to various benchmarks, which are different from study to study. This effect raises a question of efficient market theory and is a serious concern for investors making them more worried about investing in a long-term asset class such as IPOs (Żyła, 2022)

Some of the pioneering evidence on this topic was presented by Ritter (1991), who considered such anomalies as initial underpricing together with long term underperformance where more attention was drawn to the second phenomenon, the results of a study consisted of sample of 1526 US IPO companies from 1975-1984 indicated an impressive underperformance after deducting an initial return of 14. 32%, which is the difference between the market price and the offer price at the end of the first trading day, the results were 34.37% for IPO companies over a time period of 3 years, while a control group of industry- and market capitalization-matched companies returned 61.86%

The later paper of Yi J.-H. (2001) that paid an additional attention to the effect of positive and negative earnings prior the IPO supported these results by finding strong underperformance among 1032 companies that went public over 1987-1991 period on the US market relative to both the NASDAQ index and the matching market established firms, where initial underpricing was found in line with Ritter 1991 with 9.70% and 10.04% respectively for positive and negative sample while notes that companies reporting more positive pre-IPO earnings experience less severe underperformance resembled returns of market by just -0.18% underperformance over 3 year,

while poorer earnings have a worse effect on IPOs with -32.49% compare to the index benchmark, which the author believes can be explained by a theory of investor overoptimism.

Another recent study of the period from 2003-2010 by King & Banderet (2014) , with a data sample of 588 U.S. IPO firms, where a particular focus was dedicated to the comparison of results during non-crisis and crisis periods showed contradictory findings in which the impact of the crisis had a better effect on the average market returns of companies for the time after IPO in 3 years term, expressed in an excess of 26% over the average returns of non-crisis firms, unlike the other sample group of companies that conducted IPOs in a more stable times in terms of market conditions suffered 22% underperformance.

Finally, Ritter (2023) through a comprehensive set of studies from 1980 to 2021 indicated an average 3-year buy-and-hold return of 19.6% and -18.7% when market-adjusted, meaning that the market was able to considerably outpace the potential investment earned from buying IPOs at the beginning of the first trading day. The results should be also perceived with caution, as the large sample and long timeframe that were used may not give the full understanding as they may include outliers, anomalies, or changes in market conditions that are able to skew the findings to some extent. However, the author provided more evidence on the effect of total sales, profitability that the company report before initial offering, it demonstarted that there is likely correlation with 3-year aftermarket performance as the companies with higher sales and profitability strongly bypassed those firms with worse reported financials, it gives a credit to the assumption that investors trust more companies that have already proven to maintain a stable financial growth and therefore are more likely to follow this direction in the future

It appears that underperformance of initial public offerings does not seem to be an exception for only a single market and its related specifics and regulation, many international studies have successfully documented similar evidence, for instance the Tan & Kim (2017) found 16.8% underperformance of 1313 Chinese companies for the period from 1987-2015, the Zhang & Zhang (2017) were investigating a similar phenomenon in the New Zealand market among recently launched IPOs in the market found varying findings from -6.4% to -19.7% compared to their longer trading firm peers in the market. Moreover, the author identified the worst performing companies were those IPOs with smaller capitalization and leverage IPOs that yielded between -30.2% and -49.1%,

on the other hand companies with larger market capitalization, higher sales forecasts and higher leverage showed the ability to outperform with 6.6% and 17.5%. Another international study from the ASEAN region comprising Malaysia, Singapore, Thailand, the Philippines, Thailand, Vietnam, Myanmar and Laos pointed to mainly domestic market outperformance in the health care industry from 1984- 2014 by 5.57%, although the data was variable across individual markets (Komenkul & Kiranand, 2017)

2.6 Effect of Covid-19 on the U.S. Financial Markets

The recent Covid 19 virus, which originated in one of China's Wuhan provinces in 2019, has presented the world with a serious challenge, spreading at an accelerated pace across the globe, thereby forcing countries to react quickly and take measures to stop the infection and minimize negative consequences. The pandemic has had a serious impact on all spheres of national and social life, especially in the financial global markets, introducing significant uncertainty and instability. As for the US market, the economy experienced one of the sharpest declines of 29.9 % in the second half of 2020 (Apergis et al., 2023). Furthermore, the new crisis associated with the COVID-19 virus affected the living standards of vast categories of citizens across the US directly affecting their savings and assets, including a large proportion of investors and their investments, which suffered a drop in value, the unemployment rate showed a sharp rise from 3.5% in February 2020 to 14.7% in April 2020. Additionally, 10-year U.S. bonds, the closest approximation to a risk-free instrument in the market and backed by confidence in the U.S. economy along with government protection, showed a sharp drop of 65.4% percent over three weeks from 1.56% in February 2020 to 0.54% in March 2020, reaching its lowest value in history (Shu et al., 2021).

Similarly, the stock market in the U.S. was also down, with the leading S&P 500 index comprising the 500 largest U.S. companies listed on the NYSE and NASDAQ markets by market capitalization down more than 20%, indicating the biggest decline in 30 years. Similar trend has been seen across another financial markets such as the commodities market, the bond market, the cryptocurrency market, the commercial banks market (Zhang & Neupane, 2024).

However, with the panic and uncertainty that came with Covid-19, the IPO market took this situation as an opportunity, reflected in the sharp rise in public offerings for 2020, it was a 106.9% increase over 2019 (Statista, n.d.)
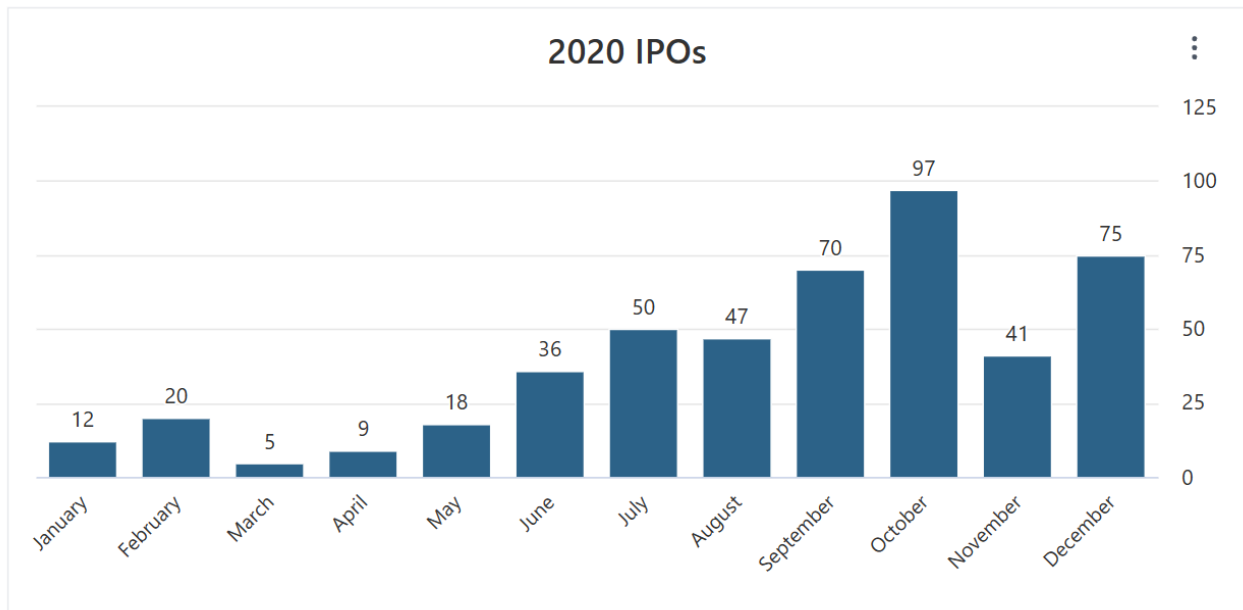
Figure 1. Number of conducted IPOs during 2020 (Statista n.d.)

A closer hindsight at the data for 2020 follows the movement of the major market indexes, with a gradual return of the growth momentum for the second half of 2020, with the highest number of public offerings in October with 97 new IPOs. This period has been termed the "IPO Frenzy", characterized by the largest amount of capital raised at $150 billion for 2020, indicating the largest IPO investment since the dot.com IPO boom of the late 1990s, largely driven by two industries healthcare and technology (Baig & Chen, 2022).

Recent studies have already tried to find various explanations for this puzzle, with the main interest in identifying the incentives driving company management to start seeking capital through public offerings. A possible reason for the rapid increase in IPO activity in the second half of 2020 is the increase in investor demand that followed the end of the bear market and the increased certainty in the market, thereby allowing new IPO companies to expect increased interest and lower risk associated with investing in initial public offerings. Additional factors that have stimulated increased activity include a low interest rate environment, gradual economic recovery and expanded testing and approval of Covid-19 vaccines. Also, the major sectors showing IPO growth involved in the technology, biotech and healthcare sectors benefited from the increased awareness of the importance of the public and investors, which was manifested due to the covid-19 pandemic (Zacharias, 2021).

2.7 Covid-19 and U.S. IPO Market

Such market anomalies as Covid-19 pandemic leading to crises occurred periodically and created certain conditions, considered in the academic world separately in relation to the performance of IPOs and highlighted in the terms cold and hot issue market, in which according to the theory proposed by Ritter (1991) the number of becoming public companies directly affects the underperformance in the long term. As the stock market experienced the steep decline that was later characterized by the highest in in the last 20 years amount of 480 newly entered the U.S. market IPOs, which can be classified as hot issue market, when the managers believe for specific reason that can be the right moment for to initiate initial offering of shares and expect long-term benefits. The Helwege & Liang (2004) notes that hot periods are distinguished by high initial underpricing, frequent oversubscription and concentration in selected industry sectors, while cold periods have lower IPO volumes, lower underpricing and reduced oversubscription incidents. Also, there is an expectation from the concept of information asymmetry that many companies that are aware of the high growth prospects and promising operating results look forward to an IPO to maximize their value, as investors are believed to be more optimistic in a hot issuance market. (Helwege & Liang 1996). And companies are making efforts to identify specific market periods when investor optimism levels are high and thus setting valuation levels to be elevated as well (Baker & Wurgler 2000)

Based on a study of Helwege & Liang (1996) conducted in the UK market among 593 companies that performed IPOs from 1985 to 2003 indicates a relationship between hot issue and underperformance level where the results did not differ when comparing the initial price as an offer price and the price of the first trading day, the study in turn found no particular relationship from the industry with the exception of the high-tech sector and the market return gained after the initial offering.

Due to the fact that the effects of Covid-19 are recent events it seems difficult to obtain research on the impact of the financial crisis following Covid-19 on the long-term performance of IPOs in the US market, thus presenting a unique opportunity and a sufficient time period for research in this thesis

2.8   Theories about long-term performance of IPOs

2.8.1   The Window of Opportunity Hypothesis.

Many companies wait for certain conditions in the market, the so-called hot issue or window of opportunity period during which there is an opportunity to take advantage of a particular time in the market that attracts more investment flows into IPO and on more favorable terms, that is to sell shares above fair value and hold this position until investors reconsider their sentiment and realize that the stock is overvalued, which will lead to a downward price correction in the future. (Żyła, 2022). Helwege & Liang (2004) note that hot periods are distinguished by high initial under-pricing, frequent oversubscription and concentration in selected industry sectors, while cold periods have lower IPO volumes, lower underpricing and reduced oversubscription incidents. Also, there is an expectation from the concept of information asymmetry that many companies that are aware of the high growth prospects and promising operating results are looking forward to an IPO to maximize their value, as investors are believed to be more optimistic in a hot issuance market Helwege & Liang (1996). And companies are making efforts to identify specific market periods when investor optimism levels are high and thus setting valuation levels to be elevated as well (Baker & Wurgler, 2000)

Based on study conducted by Helwege & Liang (1996) in the UK market among 593 companies that performed IPOs from 1985 to 2003 indicates a relationship between hot issue and underperformance level where the results do not differ when comparing the initial price as an offer price and the price of the first trading day, the study in turn found no particular relationship from the industry with the exception of the high-tech sector and the market return gained after the initial offering.

Consistent with this, Suret (2001) analyzed a similar period from 1991 to 1998 in the Canadian IPO market with the sample of 445 companies over the long term and found greater underperformance during the hot market when compared to the cold market, the results indicated that the BHAR at month 36 was -18.06% for the hot market and -10.41% for those who went public in the cold market, further at month 60 the results only worsened with -39.08% for hot IPOs and -4.6% for cold IPOs. Thus, this discovery failed to link another theory other than hot and cold market

issuance to support the rationale for the phenomenon of long-term underperformance as "divergence of opinion" and "fads hypothesis" did not prove to be the cause for these results.

2.8.2 The Impresario Hypothesis

The Fads hypothesis in regard to IPOs describes another of the possible explanations for underperformance in the long term, in which investors do not make a decision to buy an IPO based on quality information rather are more driven by the enthusiasm and optimism created around the new issue by the underwriter, which arranges initial offering process to attract more attention, for example underpricing can be as a low-cost entry ticket for an investor, with the underpricing increasing, further and new information about the firm come out as time goes returns will also be more stabilized by the market force resulting in greater underperformance (Żyła, 2022). Such manipulative initial pricing also cannot be called a fair price, thus adding to the argument that over time the price will be more reflective of the real value of the company, making its share price cheaper. Aggarwal & Rivoli (1990) add that a market may be less effective in valuing a company immediately after an IPO, therefore providing a reason for overvaluation by investors and leaving room for fads.

Aggarwal and Rivoli (1990) examined this theory by conducting a study of the long-term price movements of IPOs. They claimed that IPO markets are more susceptible to fads because the true value of new issues is difficult to estimate with limited public information before the offering and thus fads can emerge more readily. They also employed other arguments to scrutinize IPO markets, such as: noise trading is more prevalent for riskier securities; IPO investors are assumed to base their decisions more on speculation; and the speculative investor is excessively optimistic. Aggarwal and Rivoli (1990) discovered that the market valuation immediately after the IPO did not accurately reflect the genuine value of the issuer because investors were irrational. Due to the fact that investors were overly optimistic about the value of newly public companies, IPOs were underpriced. Aggarwal & Rivoli (1990)

2.8.3 The Divergence of Opinion Hypothesis

One of the theories giving an assumption explaining underperformance is the divergence of investors' opinions, which belongs to the behavioral type of theory. The essence is that investors are

divided into two groups in relation to a certain asset, pessimistic and optimistic differing in their attitude to the fair value of the financial asset and its prospects, based on the fact that a recent IPO company publishes a limited amount of information optimistic market participants may outweigh at the beginning of trading, but over time the sentiment among these groups of investors stabilizes and the pessimistic begin to play a greater role in the long term.((Żyła, 2022). In support Miller (2000) argues that the divergence in attitudes towards the company comes from future projections of dividends and financial position, different investors may use different approaches and calculations which may be incorrect over time as the company provides more and more detailed financial data, the split of opinions grows, this inevitably calls into question the homogeneous investor behavior embedded in the efficient market theory

Loughran et al., (2001) also add that the effect may be related to the part of pessimistic investors who wait for the removal of restrictions on selling after a short period of IPO issuance, for example, the SEC in the U.S. imposes a restriction on lending shares held by the underwriter within 30 days after the IPO, although based on the risk of such a transaction and the necessary extensive commitments, many pessimistic market participants continue to hold shares. Similarly, Miller (2000) asserts that in the minor international markets where short selling without a mandatory hold period is possible, it has little effect

2.9   Factors determining IPO performance

This is important in order to determine which of the factors mentioned in the previous literature relating to company performance correlate with post-IPO performance. Thus Jong-Hwan (2001) suggests that there is a correlation between higher earnings expressed in EPS value before IPO initiation and performance in the long term compared to companies with worse earnings, while both groups of companies underperformed the NASDAQ index, the group with positive values brought significantly higher market returns after 3 years, which can be explained by the fact that investors show more confidence in higher quality companies in the long term. In addition Ritter (2023) provided similar results by separating the investigated sample between unprofitable and profitable companies with the data on profitability 12 months before the IPO, indicating a clear relationship with long-term post-IPO market performance and the profitability factor, thus profitable companies brought an average of 34% after 3 years while unprofitable were only

capable of -0.3%, although both groups underperformed the index. Another study using return on assets ROA and return on sales ROS as a measure of profitability indicates despite high market returns in the short term for the more profitable companies, couldn't form relationship between the two in the long term, although this correlation was questioned because many companies can manipulate profit margins to increase attractiveness at the time of IPO, the author argues that this may lead to lower long term market returns in the aftermarket. (Lizińska & Czapiewski, 2014)

According to Mackintosh (2021) sales are the main and most influential financial factor at the time of IPO, based on the data companies with sales over 100 million dollars outperform in long-term market returns those companies with sales less than 100 million dollars without giving importance to profitability, while non-profitable companies with high sales outperform non-profitable companies with lower sales

Other factors relating to the company's performance can also influence post-IPO performance, as size was found to have a negative correlation with initial market returns and a positive correlation with long-term market returns, meaning that as the size of the company increased at the time of the IPO, long-term market returns increased (Lizińska & Czapiewski, 2014).

Another study by the author supports the relationship between size and offer size at the time of IPO and long-term market performance, but adds that the relationship weakens for time periods longer than 3 years (Zhao et al., 2022)

Similar results were recorded in Smadar & Mahmoud (2022) study, which indicates that smaller firms bring lower returns in this case measured in CAAR, which was -113.91% compared to large companies, which resulted in -25.57%, in addition, older companies were able to deliver greater long-term performance due to reduced uncertainty for investors, therefore the author advises when considering IPO for companies to wait for greater maturity and increased market presence measured in size, at the same time it was found that there is a different age dynamics of going public, while for the healthcare sector on average it is 10 years, industrials make decesion to enter the public traded market on average at 30 years The research of Akhigbe et al. (2006) suggests that IPOs are associated with long-term underperformance of the industry, as the IPOs may indicate overvaluation, increased competition, or reduced growth opportunities for the existing

firms. The long-term underperformance varies by the characteristics of the IPOs and the rivals, such as the size, age, regulation, and valuation.

3   Hyphothesis formation

Hypotheses are the certain assumptions of the author that are supported by the reviewed literature on the specific topic. Based on the theory that has been obtained through comprehensive research, the author proposes following hypotheses:

H1: The market performance of U.S. IPOs in 2020 is lower than the performance of the Nasdaq and S&P 500 indexes.

H2: The market performance of U.S. IPOs in 2020 is lower than the performance of matched established companies in the same industry and size.

H3: There is a positive correlation between total sales and ROA and the market returns of U.S. IPOs over 2020-2023 years.

4 Methodology

The following chapter is intended to describe the methodology that will be used in the research. The main program for the calculations will be MC Excel, where in addition to the analysis of the long-term performance of IPOs, non-IPOs and indexes, a multiple linear regression (MLR) is constructed.

4.1 Research design

Research design is an essential aspect of writing a research paper that helps bring planning to research methods in the form of collecting data relevant to the research problem and subproblems (Leedy & Ormrod, 2015). Creswell (2009) supports that research designs present a plan and adds that they normally include three main elements consisting of philosophical assumptions, strategies of inquiry, and specific research methods. Thus, the choice of research design is determined by considering these three components, however, the personal experience of the researcher and the potential audience of readers for whom the literature is intended plays a significant role. Morgan (2014) suggests that research design links assumptions from research questions presented as "why to" questions with appropriate methods or strategies for answering those "how to" questions. It's also worth noting, that the choice of research design depends on the research objectives, the nature of the research problem, the availability of data, and the preferences of the researcher. Different research designs have different strengths and limitations in terms of validity, reliability, generalizability, and ethical considerations (Creswell, 2009).

4.2 Quantitative approach

The data obtained during the research are distinguished into two general types, the qualitative one focusing on the numbers or quantities of a particular variable used for analysis, while the qualitative one draws attention to the characteristics or qualities that cannot be perfectly explained in the form of numbers (Leedy & Ormrod, 2015). For this study, quantitative research analysis is chosen because testing the hypotheses proposed by the author requires large amounts of data and their further analysis without the need to apply one of the techniques of qualitative analysis. A quantitative approach is characterized by the adherence to research objectives that are

aligned with objectivity, such an approach strives to reduce the author's own bias and to limit the interference of the researcher in the data collection and analysis process, by using a quantitative method, the author aims to produce generalizable and replicable results that can be verified by other researchers (Morgan, 2014). Theare are other notable components of quantitative approach according to Morgan (2014) that are deduction, which tests theory through observations using experimental design; objectivity, which separates data collection and analysis and emphasizes measurable things; generalization, which emphasizes replication and analyzes variables; and number of cases, which uses experimental and statistical controls.

4.3   Data collection and sample size

The time period being chosen for IPO sample includes the timeline from January 01, 2020 to October 31, 2020, the interval during which companies went public in unexpectedly large volumes. This timing fits well with the additional objective of this study of determining the long-term performance during Covid-19 pandemic in the U.S. IPO market since most governments around the world have already imposed restrictions and the World Health Organization recognized Covid-19 as a "Public Health Emergency of International Concern" on January 30, 2020. As events unfolded quickly, 2020 was a year of both declines in global indexes and a sharp recovery in the second half, which similarly affected the IPO market. The time frame for the research chosen tracks long-term returns in 12 months, 24 months, 36 months from the start of trading on the exchange to the present ending October 31, 2023. The studied portfolio includes a sample of 150 companies out of a total of 480 companies that went through IPO procedure in 2020 on NASDAQ, NYSE and NYSEAMERICAN exchanges, divided equally by industry and size. Then, the matched portfolio for similar long-term market analysis includes 150 companies that did IPO at least 3 years earlier than the studied sample and also selected with relative accuracy by industry and size. Appendix 1 can show the full sample of IPO companies along with the matched group of companies and industrial classification.

Then, the author is using the S&P 500 and NASDAQ index as a benchmark to determine the average Buy-and-hold abnormal return for the IPO portfolio, although two indexes were chosen to improve the reliability of the study and offer additional perspective to compare the results each stock from the studied IPO sample is compared closing price to the similar monthly closing price of the S&P 500 and NASDAQ, this approach hopes to be more accurate for the final results

Table 1. Distribution of 150 IPO companies among industries

Industry	Number of stocks
Communication Services	7
Consumer Discretionary	16
Consumer Staples	11
Financials	15
Healthcare	63
Industrials	4
Real Estate	7
Technology	27
Total	**150**

Table 2. Stock exchange allocation of 150 IPO companies

Stock exchange	Number of stocks
NASDAQ	115
NYSE	32
NYSEAMERICAN	3
Total	**150**

The bulk of the data relating to IPO prices and announcement dates were collected from various internet resources that aggregate stock exchange information and provide it to investors online, which is considered as data obtained from secondary sources, the rest of the necessary data for the second part of the study relating to financial information for each selected company in the IPO sample such as ROA and Total sales were collected from the official government internet resource Security and Exchange Commission https://www.sec.gov/edgar, where the document prospectus is published under the form 424B already mentioned in the previous chapters which includes financial reporting for the years preceding the IPO to demonstrate to potential investors and to fulfill obligations from the side of the state regulator. Although many companies publish financial statements for more than 2 years prior to the IPO, there are a number of exceptions for companies making the minimum threshold of audited financial records 2 years, so the study is conducted by collecting ROA and Total sales data for the 2 years prior to the IPO.

However, during the collection of data on ROA and Total Sales, the author encountered challenges associated with data collection process, such as instances that out of 150 companies of the original sample, several firms had a record of financial data only for the past year, thus preventing their inclusion in the regression part, it was also noticed that many foreign companies looking for capital from investors in the U.S. market publish data denominated in foreign currencies, so for the study they are translated by the author into U.S. dollars at a rate close to the time of IPO. Finally, there was a tendency among pharmaceutical companies to go public in the absence of commercial activity and lack of any profit, while at the same time incurring losses, as medical products were at the stage of either testing or approval by official authorities. In light of these findings, the final sample for the regression consists of 100 companies that completed IPOs in 2020

4.4   Data Analysis Methods

4.4.1   Buy-and-hold Abnormal Returns

The author employs the 12, 24, and 36 months buy-and-hold abnormal return method (BHAR). This method is defined as the difference between the realized buy-and-hold market return between IPO companies and the buy-and-hold market return of the index benchmark and matched portfolio of companies. The resulting abnormal return is used to measure the performance of IPO companies relative to the mentioned assets. This method is widely used for event type studies such as earnings announcements, dividend initiations, stock splits, mergers and acquisitions and especially for IPO studies. It has a number of advantages, for example, it is useful at reflecting changes in the investor's capital in the stock over long holding period for the event window (Smith, 2009). It also does not rely on distributional assumptions and is based more on signs of abnormal returns, so it can be considered as less sensitive to outliers or extreme values (Smith, 2009). However, it has some vulnerability, such as skewness bias since it is quite common to observe some IPOs exceeding high annualized return and after adjusting for the selected benchmark can skew the results heavily positively (Lahti, 2021).

The formula below illustrates buy-and-hold abnormal returns (Komenkul et al., 2017):

$$\text{BHAR}_{i,h} = \prod_{t=1}^{h}(1 + R_{i,t}) - \prod_{t=1}^{h}(1 + R_{m,t})$$

where *BHARi,h* is the abnormal return of the asset *i* over the period *t*, *Rit* is the month *t* simple return of the asset *i*, and *R,m* index return in the month *t* expressed by simple return in this case by indexes S&P 500 and NASDAQ

4.4.2   Regression Inputs

Multiple linier regression (MLR) analysis can be used to assess the correlation between two or more variables, the variable under study is referred to as intercept or (dependent variable) and explanatory variables (independent variable) (Muhamad, 2023). This method offers the means to quantify the influence of each variable, model complex interactions, and comprehend the various factors affecting the dependent variable (Keith, 2015). In addition, the possibility of interaction of regression coefficients and the ability to control for confounding variables make multiple linear regression a valuable tool for hypothesis testing and prediction, enhancing its applicability in empirical research. (Keith, 2015)

In this particular paper, a multiple linier regression (MLR) is constructed to find the relationship of the hypothesis about the correlation between the dependent variable buy-and-hold abnormal returns and the independent variables Return on Sales (ROA) and Total Sales of the company 2 years before IPO, the control variables added to the regression are Size, Age and Industry effect.

Multiple Linier Regression used in this study is shown by the formula below, the data of the variables can be found in Table 3

$$Y_{BHAR} = \beta_0 + \beta_1(X_{ROA}) + \beta_2(X_{TSALES}) + \beta_3(X_{SIZE}) + \beta_4(X_{AGE}) + \beta(X_{CMTSERV}) + \beta(X_{CONSDISC})$$
$$+ \beta(X_{CONSSTAP}) + \beta(X_{FIN}) + \beta(X_{HEALTHC}) + \beta(X_{IND}) + \beta(X_{REALEST}) + \beta(X_{TECH})$$
$$+ \beta(X_{YEAR2018}) + \beta(X_{YEAR2019}) + \varepsilon_i$$

Table 3. Description of all Variables used in the (MLR) analysis

Variable	Code	Formula
Buy-and-hold abnormal returns	X_BHAR	*Difference between 36 and 12 months*
Total Sales	X_TSALES	*Natural logarithmic value of Total Sales*
Return on Assets	X_ROA	$ROA = \dfrac{Net\ Profit}{Total\ Assets}$
Size of the company	X_SIZE	*Natural logarithmic value of Total Assets*
Age of the company	X_AGE	*Age*
Communication Services	X_CMTSERV	*Communication Services*
Consumer Discretionary	X_CONSDISC	*Consumer Discretionary*
Consumer Staples	X_CONSSTAP	*Consumer Staples*
Financials	X_FIN	*Financials*
Healthcare	X_HEALTHC	*Healthcare*
Industrials	X_IND	*Industrials*
Real Estate	X_REALEST	*Real Estate*
Technology	X_TECH	*Technology*
Year 2018	X_YEAR2018	*Year 2018*
Year 2019	X_YEAR2019	*Year 2019*

5 Findings

This chapter reveals the empirical results obtained during the buy-and-hold abnormal returns analysis against the S&P 500 and NASDAQ indexes, as well as a set of similar companies. This chapter provides descriptive statistical results for BHAR in 3 separate tests and correlation matrix

results along with multiple linier regression (MLR) to relate financial performance expressed in Return on Sales (ROA) and Total Sales to BHAR's long-term abnormal returns.

5.1   Descriptive Statistics

For the initial stage of part of the calculations, the method of descriptive statistics is used, which provides a simplified analysis of the data used in the study in an organized and accessible way (Marshall & Jonker 2010). Descriptive statistics can help to describe the main features of a data set, such as the distribution, the central tendency, and the variability of the values. It can also help to compare different groups of data or to find patterns and relationships among variables (Nicholas, 2006). Descriptive statistics is a valid and widely used method because of its ability to simplify large amounts of data and present it in a clear and meaningful way (Marshall & Jonker 2010). In our sample, the variables are Buy-and-hold abnormal market returns of IPO sample companies compared to the market returns of three separate samples including the S&P 500 index, NASDAQ and 150 matched companies for a period of 12, 24 and 36 months starting after the first month of trading. All calculations are done in MC Excel and presented in the same format.

5.2   Buy-and-hold abnormal returns of IPO companies and S&P 500 index

Table 4 illustrates the result of the first descriptive test, with data grouped by individual statistical characteristics. Here we can see that the IPO sample exhibits a pronounced underperformance of abnormal BHAR returns compared to the S&P 500 index over all 3 time periods, resulting in -17.71% for 12 months, -60.94% for 24 months and -78.55%, indicating a consistent trend towards smaller market returns over the longer term. It is also fair to note how sharply the values fall with between the first and second year, but observe a less sharp trend between the second and third year. The median, which is as mean and mode indicators of the central tendency as well as mean is negative -41,89% for 12 months, -81,47% for 24 months and -103,47% for 36 months, this indicator is known for being less sensitive to the extreme values and in this case, it produces the

similar tendency towards more negative returns over the time, however the values are indicate even more severe underperformance.

There is a wide variation in the data range, which is 5.90 from the beginning, however, the range becomes narrower as it moves from 12 months to 36 months, decreasing to 3.72, which may indicate a decrease in underperformance variation among IPO sample, which also suggests that the data becomes less dispersed as the time interval increases. Meanwhile, the maximum value of abnormal returns equals 473.36% which can be interpreted as a very high result related to the company Asana Incorporated. In contrast, the minimum value for the dataset is -117.10% underperformance against the benchmark S&P 500 index for 12 months related to Spruce Biosciences Incorporated. The maximum values for 24 and 36 months no longer exceeds the value for 12 months while the minimum falls to -159.14% for 24 months observation.

Similarly, the standard deviation, which is a measure of how much the data in the sample dispersed away from each other shows a strong variance from 12 months of 1.0051, 24 months of 0.7021 to 36 months of 0.6810. This fact implies high volatility for the short term and a potential decrease in variation over time. To the same extend, it indicates a trend towards greater stability and consistency in underperformance after the IPO as the time interval rises. From the investors' point of view, this can be a sign that, on average, the underperformance of IPOs tends to become more predictable and less variable as the investment horizon lengthens.

To describe how the shape of the distribution of dataset for IPOs BHAR and the S&P 500 index we can look at the kurtosis and skewness indicators. The Kurtosis indicator in this case is significantly positive for 12, 24 and 36 months is 8.30, 7.47 and 6.57 respectively, which significantly exceeds the normal distribution level of 3 and can suggest that the variance is greatly influenced by the outliers rather than the bulk of the data, meaning that the shape has a high and thin peak with heavy tails, however gradually approaching 36 months this graph become slightly shorter peaked and the tails are less heavy, suggesting a decrease in extreme values although still many extreme underperformance cases that largely influence the test are exist.

Referring to the skewness test, which determines the symmetry of shape around mean, we can state that the distribution of the data of long-term IPO under-performance in this case is

distributed asymmetrically with a positive slope and strongly right-skewed. In this test the norm is 0, so the obtained data 2.6464, 2.4099 and 2.3795 are strongly above the norm. From this we can conclude that the distribution is leaning towards more positive outcome.

Table 4. Descriptive statistics for 12, 24, and 36 months of IPO and S&P 500 BHAR results

	12 moths	24 moths	36 moths
Mean	-0.177120975	-0.609438672	-0.785481111
Standard Error	0.082073716	0.057333493	0.055603903
Median	-0.418941313	-0.814670563	-1.034714878
Mode	3.686384255	2.750413556	2.066281928
Standard Deviation	1.005193624	0.702189016	0.681005947
Sample Variance	1.010414222	0.493069415	0.4637691
Kurtosis	8.302394557	7.472574652	6.567518947
Skewness	2.646354115	2.40988159	2.379473737
Range	5.90460891	4.341777291	3.722508844
Minimum	-1.17098204	-1.591363735	-1.538564904
Maximum	4.73362687	2.750413556	2.18394394
Sum	-26.56814622	-91.41580081	-117.8221667
Count	150	150	150
Confidence Level(95.0%)	0.162178744	0.113291738	0.109874045

5.3 Buy-and-hold abnormal returns of IPO companies and NASDAQ index

Table 5 summarizes the results of descriptive statistics for Buy-and-hold abnormal returns of IPO firms and NASDAQ composite index. The results are as follows, on average IPO companies experienced an increasing underperformance of -21.72% by 12 months, -49.36% by 24 months and -70.81% by 36 months. These findings follow the same pattern as the S&P 500 index, remaining within roughly the same boundaries for all time intervals. This finding can be explained by the fact that both indexes are very similar in market behavior and have a similar impact on abnormal returns of IPO companies. Based on this, we can conclude that underperformance persists and shows a steady decline in performance by month 36. Similar is applied to the median equal to -46.65% for 12 months, -67.76% for 24 months and -95.53% for 36 months, meaning that the midpoint of the underperformance distribution is also negative as in the previous test.

Range in this case closely follows previous results, equal to 5.91 by 12 months as in the first analysis decreasing to 3.73 by 36 months, indicating very similar behavior between the two tests and less dispersion and variation in results as the longer time frame occurs. The maximum and minimum also show a strong difference in results at month 12 resulting in a 472.17% for the highest abnormal return and a lowest of -118.37% for the worst performer. It is important to note that the record holders remain the same Asana, Incorporated and Spruce Biosciences, Incorporated. At month 24 and 36, the results also do not go beyond the dynamics observed in the first test

The kurtosis values of 8.1131, 6.2579 and 6.2127 for 12, 24 and 36 months also indicate a strong excess of normal distribution and present a high and narrow peak together with heavy tails, the date is distributed mostly in the center and less at the tails, being influenced by sharply high underperformance values, although these cases become less frequent as the time horizons increase. Skewness 2.6098 2.1174 2.3152 for 12, 24 and 36 months indicates that the data is strongly asymmetric and the tail is more pronounced to the right side, this indicates that the extreme values in the distribution are more to the right and closer to the average on the left side of the curve. For investors, this implication could mean that investing in IPOs can have many small losses, along with occasional large gains.

Table 5. Descriptive statistics for 12, 24, and 36 months of IPO and NASDAQ BHAR results

	12 moths	24 moths	36 moths
Mean	-0.2171502	-0.49357397	-0.708075998
Standard Error	0.080628963	0.056574355	0.055228193
Median	-0.466530105	-0.677616114	-0.955326085
Mode	3.503179027	2.656471179	2.068968725
Standard Deviation	0.987499089	0.692891512	0.676404457
Sample Variance	0.975154451	0.480098647	0.457522989
Kurtosis	8.113085725	6.25790596	6.212710576
Skewness	2.609781065	2.117439804	2.315219321
Range	5.905317157	4.341777291	3.726600369
Minimum	-1.183660339	-1.685306112	-1.535878107
Maximum	4.721656818	2.656471179	2.190722262
Sum	-32.57253007	-74.03609547	-106.2113997
Count	150	150	150
Confidence Level(95.0%)	0.159323893	0.111791671	0.109131636

5.4 Buy-and-hold abnormal returns of IPO companies and matched companies

The data for comparison of Buy-and-hold abnormal returns of IPO companies and matched industries and size companies obtained from descriptive statistics are presented in Table 6. Based on the results, the companies were able to generate negative abnormal returns of -48.96% for 12 months, -53.89% for 24 months and -46.82% for 36 months. These figures suggest a highly pronounced undertperformance, which can be interpreted as the IPO sample in the 3 years after trading in the market have been able to deliver lower market returns than their more established peers with a longer presence in the market. Although findings are similar to existing underperformance for every of the months compared to indexes, it is not observed that there is a tendency for underperformance to worsen after 36 months.

The median for the results in turn indicates less negative values than mean, the largest for 12 months equal to -35.16% and decreasing to -18.61% by 36 months, although the underperformance phenomena persists, the values decrease for longer periods, which may indicate a decrease in the severity of the underperformance, which is differential compared to mean values that do not show a definite trend

The range is much higher than previous tests and is 19.51 for 12 months, which is a possible indication of the wide variation in results for this group. The range values decrease sharply to 11.71 and 10.02 for 24 and 36 months respectively. These high values can be attributed to the increased volatility of the group of matched companies compared to the smoother market behavior and smaller deviations characterized by both indexes.

 The standard deviation is also represented by higher values, meaning that the dataset exhibits a significant deviation from the mean at 1.76 on average for the short term, although the deviation decreases and abnormal returns become less volatile for the remaining 24 and 36 months, equal to 1.34 and 1.22 respectively

The kurtosis value of 31.9606 for 12 months is the highest of all observed periods and far exceeds the norm, as well as markedly exceeding the values for the previous tests. The data is distributed

very close to the mean and there are an increased number of outliers with extreme values of abnormal returns, so this presents a shape with an unusually high peak and heavy tails, however significantly decreasing to 15.9643 at month 24 and 10.0699 at month 36 of observation. Sceweness for 12,24 and 36 months are all negative in contrast to previous tests when all values were positive. We can conclude that the data -3.8614,-3.0746 and -2.2341 that the distribution of long term IPO underperformance is negatively skewed or left-skewed for all time periods. This means that the majority of the observations are on the right side of the mean, and there are some extreme cases of underperformance on the left side.

Table 6. Descriptive statistics for 12, 24, and 36 months of IPO and matched companies BHAR results

	12 moths	24 moths	36 moths
Mean	-0.489572206	-0.538918501	-0.468201279
Standard Error	0.143688694	0.109457243	0.099598287
Median	-0.351603168	-0.309028486	-0.186057166
Mode	#N/A	#N/A	#N/A
Standard Deviation	1.75981991	1.340571968	1.219824906
Sample Variance	3.096966117	1.797133201	1.487972801
Kurtosis	31.96059059	15.96429335	10.06991556
Skewness	-3.86140363	-3.074625382	-2.234087473
Range	19.50853691	11.70821228	10.02135408
Minimum	-14.98566164	-8.955828947	-6.580619354
Maximum	4.522875273	2.752383331	3.440734721
Sum	-73.43583093	-80.8377752	-70.23019178
Count	150	150	150
Confidence Level(95.0%)	0.283930753	0.216288954	0.196807527

5.5   Regression results

Table 7 provides an overview of the descriptive statistics data that are used in the regression analysis, these data include the dependent variable buy-and-hold abnormal returns (BHAR) and the independent variables return-on-sales X_ROA, X_TSALES with the control variables X_SIZE and

X_AGE. By looking at these findings many conclusions can be drawn which can guide the course of further research in correlation matrix and multiple linier regression (MLR).

The data show that the average BHAR estimated in this case in 12- and 36-month intervals to create the dynamics necessary for mathematical calculations equals -42.15%, which generally repeats the previous findings of research and once again indicates the average underperformance of IPO companies. We can also observe similar data on the indicator's kurtosis 9.99 and skewness 2.56, which, as in the case of comparison with S&P 500 and NASDAQ indexes, exceed the normal distribution and do not correspond to the symmetric model. Similar can be said about the standard deviation, which is equal to 0.87, which also indicates a relatively similar deviation from the mean, meaning the BHAR of the selected number of companies resembles that with a more extensive set for the previous tests.

Furthermore, relative to *X_SIZE* counted as a logarithmic number total sales have a standard deviation of 0.93 suggesting a moderate dispersion around the mean. A kurtosis value of -0.41 indicates that the distribution is slightly flatter than a normal distribution, and has thinner tails and less outliers, while a skewness of 0.06 means that the distribution has roughly equal tails on both sides of the mean. Regarding the results for *X_ROA* there is a negative value of mean -55.41 meaning that most of the sample of companies in this test have negative profit margins at the time of IPO, the deviation measured by standard deviation is significant and equals 2.79 which indicates a high difference in the value of ROA among the studied set of companies. Kurtosis equal to 163.02 has an extreme high peak implying that the data has some extreme values. Skewness of -12.26 indicates that the data is very negatively skewed, which means that most of the ROA values are below the mean and there are some very low values

For *X_TSALES* was taken the logarithmic value of total sales that the company had in the interval of 2 years before the IPO, here it can be stated that the standard variance of 2.03 resembles the values for *X_ROA*, which is explained by the similar nature of these indicators, which often have a common substitutive effect and proportional change. Kurtosis 7.68 shows much lower values indicating fewer extreme values. Interpretation of moderate skewness -2.63, which is skewed to the left can be explained by the high share of low total sales and few values of high total sales.

The last variable *X_ROA* in this test indicates an average age of 20.05 years which however varies greatly from the oldest IPO company being 202 years old and the youngest being only 1 year old,

meaning that some companies only after a year since inception were ready to conduct an IPO, indicating a high risk due to the inexperience of the company.

Table 7. Descriptive statistics of variables *BHAR, X_SIZE, X_ROA, X_SALES* and *X_AGE*

	BHAR	X_SIZE	X_ROA	X_TSALES	X_AGE
Mean	-0.421486703	8.389813776	-0.554110524	7.676291368	20.05
Standard Error	0.061416144	0.065882474	0.195785635	0.143508892	2.099997009
Median	-0.621417031	8.333518812	-0.097365385	8.098843352	10
Mode	#N/A	8.177703837	#N/A	0.01	5
Standard Deviation	0.868555436	0.931718877	2.768827001	2.029522217	29.69844251
Sample Variance	0.754388546	0.868100066	7.66640296	4.118960431	881.9974874
Kurtosis	9.990432545	-0.411459277	163.0202474	7.682009465	20.68693783
Skewness	2.55645163	0.067190892	-12.26192665	-2.628503952	4.17207049
Range	6.165417447	4.530824504	38.54214257	10.79556791	201
Minimum	-1.431790577	5.862489167	-37.59264343	0	1
Maximum	4.73362687	10.39331367	0.949499139	10.79556791	202
Sum	-84.29734051	1677.962755	-110.8221048	1535.258274	4010
Count	200	200	200	200	200
Confidence Level(95	0.121109967	0.129917375	0.386080764	0.282993299	4.141102845

Table 8 shows the results of the correlation matrix between the studied dependent variable BHAR and the independent variables ROA and Total Sales, SIZE and AGE are also included in the analysis, however, the variables for industry and years are excluded.

In the correlation analysis, it is noticeable that X_TSALES is the only independent variable with a significant correlation of 0.334 with abnormal returns BHAR at 1% significance. This evidence indicates the right course of further investigation leading to multiple linier regression (MLR) to determine the relationship in more detail. The other independent variables do not show a significant relationship with BHAR based on this analysis. The variables X_ROA, X_TSALES and X_AGE show significant correlation with X_SIZE at 1% significance. Although only X_TSALES showed a significant correlation this is within the objectives of the study and thus indicates the appropriateness of the chosen research solutions and calculation techniques

Table 8. Correlation matrix between variables *BHAR, X_SIZE, X_ROA, X_TSALES* and *X_AGE*

	BHAR	SIZE	ROA	TSALES	AGE
BHAR	1.000**				
X_SIZE	0.122422248	1.000**			
X_ROA	-0.004049399	0.320**	1.000**		
X_TSALES	0.334**	0.449**	0.015515769	1.000**	
X_AGE	0.086948206	0.451**	0.084824796	0.257**	1.000**

Note: significant at the 5% (*) and 1% (**) levels, two-sided test.

Table 9 presents the outcomes of multiple linier regression (MLR) analysis, to begin with the F statistics for the model indicates the significance of the constructed model is highly significant meaning that the null hypothesis that all regression coefficients are zero can be rightfully rejected. Also, Multiple R equal to 0.573 means rather moderate positive linear relationship between the dependent variable and the independent variables in this (MLR) model. Among the significant values we can observe *X_SIZE* which positively affects intercept BHAR and equal to 0.179 suggests that, on average, larger companies may experience more favorable long-term abnormal returns. Also, the significant value for *X_FIN* has a strongly negative coefficient of -0.828 which can be interpreted as that companies belonging to the financial industry may be subject to greater long-term underperformance. However, based on the regression results the author has to admit an insignificant relationship between the studied dependent variable BHAR and independent variables ROA and Total Sales, which means that it is not possible to confirm or refute the hypothesis, as well as the other independent variables are not significant in relation to BHAR in this model.

Table 9. Regression between variables *BHAR, X_SIZE, X_ROA, X_TSALES* and *X_AGE*

	Coefficients	t Stat
Intercept	-0.489	-0.678
X_SIZE	0.172*	2.233*
X_ROA	-0.012	-0.575
X_TSALES	-0.061	-1.784
X_AGE	0.000	0.079
X_YEAR2018	0.000	65535.000
X_YEAR2019	-0.593	-5.602
X_CMTSERV	-0.434	-1.199
X_CONSDISC	-0.159	-0.468
X_CONSSTAP	-0.690	-1.931
X_FIN	-0.828*	-2.373*
X_HEALTHC	-0.611	-1.851
X_IND	0.000	65535.000
X_REALEST	-0.572	-1.426
X_TECH	-0.446	-1.385
Multiple R	0.572815033	
R Square	0.328117062	
F statistics	6.987**	
Observations	200	

Note: significant at the 5% (*) and 1% (**) levels

6 Discussion

The next chapter presents an overview of the results of Tables 1,2 and 3 presenting the findings of descriptive statistics measured buy-and-hold abnormal returns for the 2020 IPO companies compared to the S&P 500, NASDAQ indexes and matched companies over a period of 12, 24 and 36 months. Here, Multiple Linier Regression (MLR) results are also analyzed with reference to the relationship between companies' financial factors return on sales (ROA) and Total Sales and their impact on the long-term buy-and-hold abnormal returns of IPO companies

> H1: The market performance of U.S. IPOs in 2020 is lower than the performance of the Nasdaq and S&P 500 indexes.

The first hypothesis is fully confirmed in the study. IPO companies are found to highly underperform market indexes, so the long-term results for 36 months indicate -78.55% abnormal returns in relation to the S&P 500 and -70.81% abnormal returns referring to the NASDAQ composite. In addition, over the shorter observation periods of 12 and 24 months, companies also performed worse relative to the index. Over 12 and 24 months, the companies were able to deliver -17.71% and -60.94% abnormal returns compared to the S&P 500 and -21.72% and 49.36% compared to the NASDAQ. These findings may provide further evidence and support for the phenomenon of long-term underperformance of IPO companies.

> *H2: The market performance of U.S. IPOs in 2020 is lower than the performance of comparable established companies in the same industry and size.*

The second hypothesis put forward by the author was also confirmed in the course of the study, so it was found that IPO companies demonstrate worse abnormal returns in comparison with similar in size and industry set of companies. Long-term buy-and-hold abnormal returns for 36 months were equal to -46.82%, which is a better result in comparison with indexes. Short-term returns for 12 and 24 months in turn show -48.96% and -53.89% underperformance. These results proved to be additional evidence in the theory of long-term underperformance of IPO companies by showing less negative however similar results in comparison with indexes.

> *H3: There will be a positive correlation between total sales and ROA and the market returns of U.S. IPOs over 2020-2023 years.*

The last hypothesis according to the results of multiple linier regression (MLR) indicating the lack of the correlation between ROA and Total Sales do not give a chance to state that the hypothesis is justified, but because the results also did not confirm the opposite result it is impossible to reject this hypothesis. The author assumes from the obtained significant correlation presented in the correlation matrix between Total Sales and BHAR that increasing the sample in further studies may be able to provide more accurate and explanatory conclusions.

7   Limitations and Recommendations

Although this paper provides a valuable updated overview of the topic and is primarily based on a study of long-term IPO performance in the US stock market, it has a number of limitations and opportunities for development in future research. The data provided in this study using the BHAR methodology despite its extensiveness and the involvement of most industries and company sizes cannot be considered absolutely complete for the year 2020, as it involves more database requirements than what the researcher had access to in this study. Considering that the BHAR technique of detecting long-term performance is a popular and widely applied technique in IPO research it is the only method used in this study, therefore the author may recommend the use of additional approaches to validate the results such as cumulative abnormal returns (CAR) or calendar-time portfolio. In terms of the impact of Covid-19 this study could also be extended in further research by taking a sample of IPO companies that went public before the events of the financial crisis in 2020 and track their long-term market returns to possibly describe how Covid-19 can be considered the cause of such severe underperformance observed in this study, however it is important to select portfolios closely matched. Given that this study focuses more on the long-term performance of companies, it may involve testing shorter-term theories surrounding IPO topic such as initial underpricing and its potential relationship with long-term performance.

While collecting information on pre-IPO financial data published in the prospectus, the author faced difficulties due to the lack of general requirement for declaration and financial reporting, some categories of companies are allowed not to publish more than 2 years of previous financial record if they have not reached a certain turnover in terms of revenue, this also applies to companies that have not made commercial profits, which is also supplemented by reporting in foreign currencies that need to be converted. All these difficulties were overcome during the study but they may have affected the results, so further research should pay attention to this concern. Regarding metrics that have a potential impact on underperformance future research could employ a more extensive set including more in-depth various company metrics from profitability ratios, leverage ratios, liquidity ratios, growth metrics, also regarding the IPO process gross proceeds, size of offering, offer price, underwriters' reputation.

8   Conclusion

To conclude, this thesis uncovered new evidence by examining a sample of 150 companies that performed IPO in 2020 in support of the long-term underperformance theory discussed in the IPO topic. More specifically, this study examined the market performance of companies between 2020-2023 using the buy-and-hold abnormal returns methodology and found a pronounced un-derperformance against the S&P 500 and NASDAQ indexes, which showed a declining trend in per-formance with increasing time intervals. To verify these findings, a comparison with 150 similar size and industry portfolios was also conducted, which confirmed weak long-term market returns, but did not show a gradual deterioration with increasing time intervals.

Although this study did not separately analyze IPO performance for the period before and after Covid-19, the results obtained from this study indicate that the impact of the financial crisis fol-lowing Covid-19 on long-term abnormal returns cannot be excluded, as strong evidence of under-performance was found, which may serve as a basis for future research focusing on the impact of Covid-19 on the IPO market.

To find factors possibly influencing this effect of negative long-term market returns, multiple re-gression analysis (MLR) was conducted in which influential financial indicators such as profitability (ROA) and Tota Sales were considered. Despite the found evidence of correlation between Total Sales and BHAR, the final regression data could not confirm this relationship. Thus, without ac-cepting or rejecting the hypothesis, it is still not possible to understand which factors related to the financial performance of the company may influence the long-term market performance.

The findings of this thesis have significant implications for various stakeholders in the initial public offering process. The evidence supports the long-term underperformance anomaly among compa-nies that went public in 2020 and suggests that investors, underwriters, regulators, and the com-panies themselves need to carefully assess and manage expectations regarding post-IPO perfor-mance.

References

Aggarwal, Reena and Rivoli, Pietra (1990), Fads in the Initial Public Offering Market?, *Financial Management*, 19, No. 4, 45-57, https://doi.org/10.2307/3665609

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

Aigbe Akhigbe, Jarrod Johnston, Jeff Madura (2006), Long-term industry performance following IPOs, *The Quarterly Review of Economics and Finance*, 46, 638–651, https://doi.org/10.1016/j.qref.2005.01.004

Alexander Ljungqvist (2006), IPO Underpricing, in *Handbook of Corporate Finance*, Volume 1, 375-422, https://doi.org/10.1016/B978-0-444-53265-7.50021-4

Baker, Malcolm P. and Wurgler, Jeffrey A. (2000), The Equity Share in New Issues and Aggregate Stock Returns, *The Journal of Finance*, 55, No. 5, 2219-2257, https://doi.org/10.1111/0022-1082.00285

Campbell, Cynthia J. and Rhee, S. Ghon and Du, Yan and Tang, Ning (2008), Market Sentiment, IPO Underpricing, and Valuation http://dx.doi.org/10.2139/ssrn.1108540

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches* (3rd ed.). SAGE Publications https://www.ucg.ac.me/skladiste/blog_609332/objava_105202/fajlovi/Creswell.pdf

Dang, Huong D. and Jolly, Michael (2017), Red Flags for IPO Downfalls in New Zealand, *Managerial Finance*, 43, No. 9, 1034-1051, https://ssrn.com/abstract=3427878

Ellingsen, Tore and Rydqvist, Kristian (1999), The Stock Market as a Screening Device and the Decision to Go Public, *Review of Financial Studies*, 12, No. 4, 1017-1040, http://dx.doi.org/10.2139/ssrn.75358

Elizabeth Demers and Philip Joos (2007), IPO Failure Risk, *Journal of Accounting Research*, 45, No. 2, 333-371, https://doi.org/10.1111/j.1475-679X.2007.00236.x

Eugene F. Fama (1970), Efficient Capital Markets: A Review of Theory and Empirical Work, *The Journal of Finance*, 25, No. 2, 383-417, https://doi.org/10.2307/2325486

Helwege, Jean and Liang, Nellie (2004), Initial Public Offerings in Hot and Cold Markets, *The Journal of Financial and Quantitative Analysis*, 39, No. 3, 541-569, https://doi:10.1017/S0022109000004027

Houge, Todd and Loughran, Tim and Suchanek, Gerry and Yan, Xuemin (2001), Divergence of Opinion, Uncertainty, and the Quality of Initial Public Offerings, *Financial Management*, 30, No. 4, 5-23, https://doi:10.2307/3666390

Jay R. Ritter (1987), The Costs of Going Public, *Journal of Financial Economics*, 19, 269-281, https://doi:10.1016/0304-405X(87)90005-5

Jean Helwege and Nellie Liang (1996), Initial Public Offerings in Hot and Cold Markets, *The Journal of Finance*, 51, No. 4, 1397-1418, https://doi:10.1111/j.1540-6261.1996.tb04080.x

Jean-Marc Suret (2003), The Aftermarket Performance of Initial Public Offerings in Canada, *Journal of Multinational Financial Management*, 13, No. 4-5, 377-397, https://doi:10.1016/S1042-444X(03)00038-0

Jeremy J. Zacharias (2021), The Impact of COVID-19 on the Global IPO Marketplace, PLUS Blog, March 15, https://plusblog.org/2021/03/15/the-impact-of-covid-19-on-the-global-ipo-marketplace/

Joanna Lizińska and Leszek Czapiewski (2014), Performance of Polish IPO Firms: Size and Profitability Effect, *Gospodarka Narodowa*, 1 (269), 53-71, https://doi:10.33119/GN/100885

Jong-Hwan Yi (2001), Pre-offering earnings and the long-run performance of IPOs, *International Review of Financial Analysis*, 10, No. 1, 53-67, https://doi:10.1016/S1057-5219(00)00040-2

Keith Pilbeam (2005), *Finance and Financial Markets*, Second Edition, Palgrave Macmillan, ISBN 978-1-4039-4834-9

Keith, T. Z. (2015). *Multiple regression and beyond: An introduction to multiple regression and structural equation modeling* (2nd ed.). Routledge.

King, Emmet and Banderet, Luca (2014), IPO Stock Performance and the Financial Crisis, *Journal of Applied Business and Economics*, 16, No. 4, 57-68, https://doi:10.2139/ssrn.2456220

Komenkul, Kulabutr and Kiranand, Santi (2017), Aftermarket Performance of Health Care and Biopharmaceutical IPOs: Evidence From ASEAN Countries, *The Journal of Health Care Organization, Provision, and Financing*, 54, 1-11, https://doi:10.1177/0046958017727105

Lahti, N. (2021). *IPO underpricing and long-term performance in the US stock market: Evidence from the New York and Nasdaq stock exchanges*, Master's thesis. https://aaltodoc.aalto.fi/handle/123456789/111111

Leedy, P. D., & Ormrod, J. E. (2015). *Practical research: Planning and design* (11th ed.). Pearson.

(2017). Listing in the US: Benefits and challenges.

Loughran, Tim and McDonald, Bill (2016), IPO First-Day Returns, Offer Price Revisions, Volatility, and Form S-1 Language, *Journal of Financial Economics*, 121, No. 2, 449-469, https://doi:10.1016/j.jfineco.2016.05.001

Malcolm P. Baker and Jeffrey A. Wurgler (1999), The Equity Share in New Issues and Aggregate Stock Returns, *The Journal of Finance*, 55, No. 5, 2219-2257, https://doi:10.1111/0022-1082.00285

Marco Pagano and Fabio Panetta and Luigi Zingales (1995), Why Do Companies Go Public? An Empirical Analysis, *The Journal of Finance*, 53, No. 1, 27-64, https://doi:10.1111/0022-1082.25448

Marshall, G., & Jonker, L. (2010). An introduction to descriptive statistics: A review and practical guide. Radiography, 16(4), e1-e7. https://doi.org/10.1016/j.radi.2010.01.001

Miller, Edward M. (2000), Long run underperformance of initial public offerings: an explanation, *Department of Economics and Finance Working Papers*, 16, https://doi:10.2139/ssrn.253495

Min Shu, Ruiqiang Song, Wei Zhu (2021), The 'COVID' crash of the 2020 U.S. Stock market, *The North American Journal of Economics and Finance*, 58, 101497, https://doi:10.1016/j.najef.2021.101497

Morgan, D. L. (2014). *Integrating qualitative and quantitative methods: A pragmatic approach*. SAGE Publications.

Muhamad, S. (2023). Comparison between multiple regression and Bayesian regression with application. Journal of Statistics, 6, 11-27.

Nasdaq. (2016). Advantages and disadvantages of going public using an IPO. https://www.nasdaq.com/articles/advantages-and-disadvantages-going-public-using-ipo-2016-05-17

Nicholas Apergis, Ghulam Mustafa, Shafaq Malik (2023), The role of the COVID-19 pandemic in US market volatility: Evidence from the VIX index, *The Quarterly Review of Economics and Finance*, 89, 27-35. https://doi:10.1016/j.qref.2023.03.004

Nicholas, J. (2006). *Introduction to descriptive statistics*. University of Sydney. https://www.sydney.edu.au/content/dam/students/documents/mathematics-learning-centre/introduction-to-descriptive-statistics.pdf

Perera, W. (2015). Why does underperformance of IPOs in the long-run become debatable? A theoretical review

Pešterac, Aleksandra (2020), The Importance of Initial Public Offering for Capital Market Development in Developing Countries, *Economic Themes*, 58, No. 1, 97-115, https://doi:10.2478/ethemes-2020-0006

Phil Mackintosh (2021), What Happens to IPOs Over the Long Run?, Nasdaq, July 29, https://www.nasdaq.com/articles/what-happens-to-ipos-over-the-long-run-2021-07-29

PwC Deals (2017), Roadmap for an IPO A guide to going public, PricewaterhouseCoopers LLP, https://www.pwc.com/us/en/services/deals/library/roadmap-for-an-ipo.html

Rajan, Raghuram G. (1992), The Choice between Informed and Arm's-Length Debt, *The Journal of Finance*, 47, No. 4, 1367-1400, https://doi:10.2307/2328944

Ritter, Jay R. (1991), The Long-Run Performance of Initial Public Offerings, *The Journal of Finance*, 46, No. 1, 3-27, https://doi:10.1111/j.1540-6261.1991.tb03743.x

Ritter, J. (1998). Initial public offerings. *Contemporary Finance Digest*, 2(1), 5-30.

Siev, Smadar and Qadan, Mahmoud (2022), Call Me When You Grow Up: Firms' Age, Size, and IPO Performance across Sectors, *Journal of Risk and Financial Management*, 15, No. 12, 586, https://doi:10.3390/jrfm15120586

Smith, Z. (2009). An empirical analysis of initial public offering (IPO) performance. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.1326967

Statista. (n.d.). Topic: IPOs in the U.S. market https://www.statista.com/topics/1272/ipos/

Tan, Jin and Kim, Sunghwan (2017), Effects of Exports, IPO Duration, and Government Protection on Market Returns of Chinese IPO Firms, *Journal of International Trade & Commerce*, 13, No. 3, 215-236, https://doi:10.16980/jitc.13.3.201706.215

Vipond, Tim, IPO Process, Corporate Finance Institute, https://corporatefinanceinstitute.com/resources/equities/ipo-process/

Yi, Jong-Hwan (2001), Pre-offering earnings and the long-run performance of IPOs, *International Review of Financial Analysis*, 10, No. 1, 53-67, https://doi:10.1016/S1057-5219(00)00040-2

Yi Zhao, Nan Wang, Luyang Zhang, Baiqing Sun, Yuchen Yang (2022), The greater the investor attention, the better the post-IPO performance? A view of pre-IPO and post-IPO investor attention, *Research in International Business and Finance*, 63, 101789, https://doi:10.1016/j.ribaf.2022.101789

Zhang, Xinyi and Zhong, Wenxi and Bai, Chongxi (2022), Risk Management Strategy in IPO Activity, *Advances in Economics, Business and Management Research*, 211, 1-5, https://doi:10.2991/aebmr.k.220122.001

Zikai Zhang, Suman Neupane (2024), Global IPO underpricing during the Covid-19 pandemic: The impact of firm fundamentals, financial intermediaries, and global factors, *International Review of Financial Analysis*, 91, 102954, https://doi:10.1016/j.irfa.2023.102954

Żyła, Michał (2022), Explanatory theories of stock returns in the long run after IPO – A literature review, *Financial Sciences*, 27, No. 2, 113-128, https://doi:10.15611/fins.2022.2.08

9   Appendices

9.1   Appendix 1. List IPO sample and matched companies. NYSE, NASDAQ and NYSEAMERICAN

IPO companies	Industry	Matched companies	Industry
Snowflake Inc.	Technology	Dell Technologies	Technology
Palantir Technologies Inc.	Technology	ST Microelectronics	Technology
Li Auto Inc.	Consumer Discretionary	General Motors Company	Consumer Discretionary
KE Holdings Inc.	Real Estate	Invitation Homes	Real Estate
Warner Music Group Corp.	Communication Services	Telefônica Brasil	Communication Services
Rocket Companies, Inc.	Financials	LPL Financial Holdings	Financials
Royalty Pharma plc	Healthcare	Hologic	Healthcare
Bentley Systems, Incorporated	Technology	NetApp	Technology
XPeng Inc.	Consumer Discretionary	Domino's Pizza	Consumer Discretionary
Albertsons Companies, Inc.	Consumer Staples	Lamb Weston Holdings	Consumer Staples
Legend Biotech Corporation	Healthcare	Incyte	Healthcare
ZoomInfo Technologies Inc.	Technology	Pure Storage	Technology
GFL Environmental Inc.	Industrials	AECOM	Industrials
Unity Software Inc.	Technology	Trimble	Technology
MINISO Group Holding Limited	Consumer Discretionary	Caesars Entertainment	Consumer Discretionary
Reynolds Consumer Products Inc.	Consumer Discretionary	Gildan Activewear	Consumer Discretionary
Abcam plc	Healthcare	The Ensign Group	Healthcare
Allegro MicroSystems, Inc.	Technology	Insight Enterprises	Technology
Lufax Holding Ltd	Financials	OneMain Holdings	Financials
Shift4 Payments, Inc.	Technology	Five9	Technology
Asana, Inc.	Technology	ExlService Holdings	Technology

The AZEK Company Inc.	Industrials	Valmont Industries	Industrials
Dun & Bradstreet Holdings, Inc.	Financials	Home Bancshares, Inc. (Conway, AR)	Financials
Academy Sports and Outdoors, Inc.	Consumer Discretionary	American Eagle Outfitters	Consumer Discretionary
Vertex, Inc.	Technology	BlackLine	Technology
nCino, Inc.	Technology	Silicon Laboratories	Technology
Chindata Group Holdings Limited	Technology	Celestica	Technology
Inari Medical, Inc.	Healthcare	Cytokinetics	Healthcare
StepStone Group Inc.	Financials	Burford Capital	Financials
Broadstone Net Lease, Inc.	Real Estate	Cousins Properties	Real Estate
JFrog Ltd.	Technology	Plexus	Technology
Lightspeed Commerce Inc.	Technology	Galapagos NV	Healthcare
Revolution Medicines, Inc.	Healthcare	Calix	Technology
Array Technologies, Inc.	Technology	Viasat	Technology
Jamf Holding Corp.	Technology	LiveRamp Holdings	Technology
Eastern Bankshares, Inc.	Financials	Axos Financial	Financials
Schrödinger, Inc.	Healthcare	ICU Medical	Healthcare
Pactiv Evergreen Inc.	Consumer Discretionary	Cedar Fair,	Consumer Discretionary
Beam Therapeutics Inc.	Healthcare	Xenon Pharmaceuticals	Healthcare
Harmony Biosciences Holdings, Inc.	Healthcare	Dynavax Technologies	Healthcare
Corsair Gaming, Inc.	Technology	Harmonic	Technology
CureVac N.V.	Healthcare	NovoCure	Healthcare
Kingsoft Cloud Holdings Limited	Technology	Ultra Clean Holdings	Technology
Lemonade, Inc.	Financials	Hope Bancorp	Financials
NETSTREIT Corp.	Real Estate	Chimera Investment	Real Estate
Dada Nexus Limited	Consumer Discretionary	TriMas	Consumer Discretionary
Relay Therapeutics, Inc.	Healthcare	OPKO Health	Healthcare

Keros Therapeutics, Inc.	Healthcare	Ligand Pharmaceuticals	Healthcare
Pliant Therapeutics, Inc.	Healthcare	Protagonist Therapeutics, Inc.	Healthcare
Yalla Group Limited	Technology	Benchmark Electronics	Technology
Kymera Therapeutics, Inc.	Healthcare	Innoviva	Healthcare
Leslie's, Inc.	Consumer Discretionary	Monro	Consumer Discretionary
fuboTV Inc.	Communication Services	TechTarget	Communication Services
Inhibrx, Inc.	Healthcare	Collegium Pharmaceutical	Healthcare
Montrose Environmental Group, Inc.	Industrials	Titan International	Industrials
BigCommerce Holdings, Inc.	Technology	SunPower	Technology
Thryv Holdings, Inc.	Communication Services	Clear Channel Outdoor Holdings	Communication Services
Guild Holdings Company	Financials	Eagle Bancorp	Financials
MediaAlpha, Inc.	Communication Services	AMC Networks	Communication Services
Mission Produce, Inc.	Consumer Staples	B&G Foods	Consumer Staples
Dyne Therapeutics, Inc.	Healthcare	Artivion	Healthcare
Accolade, Inc.	Healthcare	Nevro	Healthcare
Tarsus Pharmaceuticals, Inc.	Healthcare	Revance Therapeutics	Healthcare
Vital Farms, Inc.	Consumer Staples	BrasilAgro - Companhia Bra-sileira de Propriedades Agrícolas	Consumer Staples
Calliditas Therapeutics AB (publ)	Healthcare	Surmodics	Healthcare
ALX Oncology Holdings Inc.	Healthcare	Atlanticus Holdings	Financials
Velocity Financial, Inc.	Financials	Calavo Growers	Consumer Staples
Vitru Limited	Consumer Staples	Phibro Animal Health	Healthcare
Taysha Gene Therapies, Inc.	Healthcare	MacroGenics	Healthcare
Avidity Biosciences, Inc.	Healthcare	Carrols Restaurant Group	Consumer Discretionary

OneWater Marine Inc.	Consumer Discretionary	AnaptysBio, Inc.	Healthcare
ORIC Pharmaceuticals, Inc.	Healthcare	Aclaris Therapeutics	Healthcare
Pulmonx Corporation	Healthcare	SIGA Technologies	Healthcare
iTeos Therapeutics, Inc.	Healthcare	Community Health Systems	Healthcare
American Well Corporation	Healthcare	Spok Holdings	Healthcare
COMPASS Pathways plc	Healthcare	Invesco Mortgage Capital	Real Estate
NexPoint Real Estate Finance, Inc.	Real Estate	NVE Corporation	Technology
Agora, Inc.	Technology	Universal Technical Institute	Consumer Staples
Vasta Platform Limited	Consumer Staples	bluebird bio	Healthcare
Nano-X Imaging Ltd.	Healthcare	AudioCodes	Technology
IBEX Limited	Technology	Innodata	Technology
Rackspace Technology, Inc.	Technology	AC Immune	Healthcare
GoHealth, Inc.	Financials	FS Bancorp	Financials
Atea Pharmaceuticals, Inc.	Healthcare	TeraWulf	Financials
SelectQuote, Inc.	Financials	Vanda Pharmaceuticals	Healthcare
Poseida Therapeutics, Inc.	Healthcare	Fennec Pharmaceuticals	Healthcare
Arcutis Biotherapeutics, Inc.	Healthcare	Fate Therapeutics	Healthcare
Inozyme Pharma, Inc.	Healthcare	Akebia Therapeutics, Inc.	Healthcare
Outset Medical, Inc.	Healthcare	EDAP TMS	Healthcare
AlloVir, Inc.	Healthcare	Coherus BioSciences	Healthcare
Prelude Therapeutics Incorporated	Healthcare	G. Willi-Food International	Consumer Staples
iHuman Inc.	Consumer Staples	Monroe Capital	Financials
Root, Inc.	Financials	Zevra Therapeutics	Healthcare
Foghorn Therapeutics Inc.	Healthcare	Selecta Biosciences	Healthcare

Lyra Therapeutics, Inc.	Healthcare	Cellectis	Healthcare
Opthea Limited	Healthcare	Rigel Pharmaceuticals	Healthcare
I-Mab	Healthcare	Seres Therapeutics	Healthcare
Praxis Precision Medicines, Inc.	Healthcare	Aldeyra Therapeutics	Healthcare
Genetron Holdings Limited	Healthcare	Lazydays Holdings	Consumer Discretionary
Vroom, Inc.	Consumer Discretionary	BioLineRx	Healthcare
Nkarta, Inc.	Healthcare	Abeona Therapeutics	Healthcare
Biodesix, Inc.	Healthcare	Esperion Therapeutics	Healthcare
Shattuck Labs, Inc.	Healthcare	Protalix BioTherapeutics	Healthcare
Black Diamond Therapeutics, Inc.	Healthcare	Adverum Biotechnologies	Healthcare
C4 Therapeutics, Inc.	Healthcare	Anixa Biosciences	Healthcare
PMV Pharmaceuticals, Inc.	Healthcare	Electromed	Healthcare
GreenPower Motor Company Inc.	Consumer Discretionary	Birks Group	Consumer Discretionary
Generation Bio Co.	Healthcare	GlycoMimetics	Healthcare
GAN Limited	Consumer Discretionary	Marchex	Communication Services
uCloudlink Group Inc.	Communication Services	Sotherly Hotels	Real Estate
Fathom Holdings Inc.	Real Estate	Cara Therapeutics	Healthcare
Athira Pharma, Inc.	Healthcare	Syros Pharmaceuticals	Healthcare
Safety Shot Inc	Healthcare	Tiziana Life Sciences	Healthcare
Aligos Therapeutics, Inc.	Healthcare	Clearside Biomedical	Healthcare
Eargo, Inc.	Healthcare	comScore	Communication Services
WiMi Hologram Cloud Inc.	Communication Services	NanoString Technologies	Healthcare
Annovis Bio, Inc.	Healthcare	Compugen	Healthcare
Kronos Bio, Inc.	Healthcare	Assembly Biosciences	Healthcare
ADC Therapeutics SA	Healthcare	Affimed	Healthcare
Renalytix Plc	Healthcare	IF Bancorp	Financials

Huize Holding Limited	Financials	Synchronoss Technologies	Technology
Ebang International Holdings Inc.	Technology	ReWalk Robotics	Healthcare
Spruce Biosciences, Inc.	Healthcare	Nicholas Financial	Financials
Passage Bio, Inc.	Healthcare	Cutera	Healthcare
Biora Therapeutics, Inc.	Healthcare	Societal CDMO	Healthcare
Sadot Group Inc.	Consumer Staples	S&W Seed Company	Consumer Staples
Lantern Pharma Inc.	Healthcare	Minerva Neurosciences	Healthcare
Zhongchao Inc.	Healthcare	vTv Therapeutics	Healthcare
Freeline Therapeutics Holdings plc	Healthcare	Retractable Technologies	Healthcare
VIA optronics AG	Technology	VirnetX Holding	Technology
Brilliant Acquisition Corporation	Financials	Avalo Therapeutics	Healthcare
Fresh2 Group Ltd	Healthcare	GigaMedia	Communication Services
Lizhi Inc.	Communication Services	Kazia Therapeutics	Healthcare
Galecto, Inc.	Healthcare	Mannatech	Consumer Staples
Skillful Craftsman Education Technology Limited	Consumer Staples	China Natural Resources	Industrials
MingZhu Logistics Holdings Limited	Industrials	JX Luxventure	Consumer Discretionary
Acutus Medical, Inc.	Healthcare	Theriva Biologics	Healthcare
Intrusion Inc.	Technology	GSE Systems	Technology
Laird Superfood, Inc.	Consumer Staples	Coffee Holding Co.	Consumer Staples
Lixiang Education Holding Co., Ltd.	Consumer Staples	Ambow Education Holding	Consumer Staples
Applied Molecular Transport Inc.	Healthcare	TRACON Pharmaceuticals	Healthcare
Quhuo Limited	Technology	MIND Technology	Technology
Presidio Property Trust, Inc.	Real Estate	CorEnergy Infrastructure Trust	Real Estate
China Liberal Education Holdings Limited	Consumer Staples	Better Choice Company	Consumer Staples

TRxADE HEALTH, Inc.	Healthcare	Trevena	Healthcare
PolyPid Ltd.	Healthcare	Titan Pharmaceuticals	Healthcare
Amesite Inc.	Technology	Peraso	Technology
Polished.com Inc.	Consumer Discretionary	SharpLink Gaming	Consumer Discretionary
Harbor Custom Development, Inc.	Real Estate	Power REIT	Real Estate
Siyata Mobile Inc.	Technology	The Singing Machine Company, Inc.	Technology