TALLINN UNIVERSITY OF TECHNOLOGY

School of Business and Governance

Eemeli Vertti Julius Niemelä

SHORT TERM MARKET REACTIONS TO NASDAQ-100 LISTINGS AND DELISTINGS IN 2014-2023

Bachelor's thesis

Programme International Business Administration, specialisation Finance

Supervisor: Kalle Ahi, Lecturer

Tallinn 2024

I hereby declare that I have compiled the thesis independently
and all works, important standpoints and data by other authors
have been properly referenced and the same paper has not been
previously presented for grading.
The document length is 8190 words from the introduction to the end of the conclusion.

Eemeli Vertti Julius Niemelä ……………………………

(Signature, date)

TABLE OF CONTENTS

ABSTRACT

As global financial markets develop and traditional investment methods become challenged, investors are actively looking for new ways to get a return on their investments. The world's most followed indexes such as Nasdaq-100, S&P 500, DJIA and Nasdaq Composite are of interest to many investors and their stocks are updated at regular intervals, with which investors update their portfolio holdings accordingly.

State aim of the thesis is to investigate short-term market reactions to the Nasdaq-100 Index in the years 2014-2023 and whether listings or delisting's produce abnormal returns or volumes. Cumulative abnormal returns are also calculated. Event study method is applied.

The results obtained from the study show that in the years 2014-2023, stocks listed in the Nasdaq-100 Inde experienced negative abnormal returns, while stocks removed from the index will experience positive abnormal returns. More research must be done to understand the root cause as this thesis do not answer to the questions such as why this happens. In both cases, stocks see abnormal volumes before the event date.

Keywords: Nasdaq, Listings, Delisting's, Abnormal Returns, Cumulative Abnormal Returns, Abnormal Volumes, Event Study

INTRODUCTION

In the global economy around us, financial markets stand out as a system due to their complexity. They not only reflect the state of the economy, but also shape its health. Financial markets that live and breathe on investments and speculative trades are arenas where fortunes and wealth are created or lost in fraction of a second. At the core of the complexity, stock indexes can be found, which not only serve as a benchmark for the general development of the market, but also as a guide for the economy and investors. Among these, the Nasdaq-100 known for showing the innovation and growth of large and leading technology companies, wraps itself in the dynamics of financial markets and continuously developing investment opportunities.

The fast pace of change in the market forces traditional investment strategies that have prevailed for a long time to look for new strategies that create better returns. Technology companies and their changing role in our society will further speed up the pace. With large growth potentials, risk and return parameters are formed anew. As the Nasdaq-100 index focuses on these companies, it offers a central research area for a better understanding of the changes. The motivation for the research is taken from Peer Pressure Hypothesis by Harris and Gurel (1898), Information Hypothesis by Schleifer (1986), studies on liquidity effects by Beneish and Whiley and Efficient Market Hypothesis by Fama (1970). Together, these emphasize the importance of market dynamics in index reorganizations, such as listing and delisting.

This research deals with listings and delisting's on the Nasdaq-100 Index affecting the performance of stocks and whether these events result in abnormal returns or trading volumes. It is also to be investigated how these variables interact with each other. The problem is derived from the observation that changes in indices lead to reactions in the market that go deeper into views of market efficiency and investor behaviour.

The objective of the study is to investigate whether listings or delisting's in the Nasdaq-100 Index lead to abnormal returns or trading volumes. Research question is formulated as:

How does stock performance and volumes change for companies before and after being listed or delisted in the Nasdaq-100 index and does it lead to positive (negative) abnormal returns or volumes?

To answer the research question, 4 hypotheses are formed, 2 of which focus on abnormal returns which are *"Companies experience positive abnormal returns after being listed on Nasdaq-100* *index”* and *“Companies experience negative abnormal returns after delisting from Nasdaq-100 index”*. The remaining two focus on abnormal volumes which are as follows *“Companies experience positive abnormal volumes after being listed on Nasdaq-100 index”* and *“Companies experience negative abnormal volumes after delisting from Nasdaq-100 index”*. The hypotheses have been formed based on the theoretical part and previous studies. Hypotheses are used to evaluate and discuss data analysis regarding abnormal returns and volumes.

This research uses event study methodology and a 10-day event window to quantify possible abnormal returns or trading volumes around listing and delisting event days. All data has been sourced from Refinitive Eikon software to ensure academic and reliable research material. The years 2014-2023 have been chosen as the research period, as it offers a decade that includes macroeconomic cycles such as bull and bear markets as well as individual market disturbances like COVID-19.

The research is divided into three parts. The first chapter deals with the market theories, previous research, and the formation of hypotheses. The second chapter contains sample selection, research methodology and measurement of variables such as abnormal returns, cumulative abnormal returns, and abnormal volumes. Possible limitations for the research are discussed. The third chapter contains analysis of listing effects, delisting effects, robustness check and a discussion. These are followed by conclusion and list of references.

1.THEORETICAL FRAMEWORK

This chapter examines the market theories which are related to listings and delisting's, previous empirical research, following formulation of the hypotheses.

1.1. Market theories

When listing or delisting stocks from the Nasdaq-100 index, there is a bigger picture involved than just Nasdaq's administrative decisions. These are events that reflect market efficiency and information asymmetry among investors. The efficient market hypothesis (EMH), formulated by Samuelson (1965) and further classified by Fama (1970), assumes that stock prices reflect all available information and there should always be a buyer for a seller. The available information and efficiency on pricing should be able to be categorized into three varied factors. Fama (1970) categorizes these with *Weak form, semi-strong form,* and *strong form.* Weak form is based on the idea that the stock price is defined by past development and pricing. Semi-strong form is based on the currently available information and strong form is based on the idea that investors would have a monopolistic position on access to information that would affect the stock price. Jensen (1965) has proven this strong-form theory in his empirical experiment which states that no group has access to anticipate future returns. For the stock market to be fully effecient, the following three things should happen according to Fama (1970): (1) all transactions should be free of cost; (2) all market participants should be able to access the same information without costs; (3) current price and future distributions should be agreed with all the market participants.

In an efficient market, the investor must be able to trust the pricing of the stocks, and investors have no chance of getting constant profits that would beat the market. To do this, you need to know more than others, which contradicts the Efficient Market Hypothesis (Brealey, et al, 2011). The real world, however, challenges this concept and its dynamics as it brings out information dissemination, liquidity, and psychology among investors. Many investors see EMH nowadays more as true on relative terms (Yasir, Mewhish, 2015).

As stocks are added or delisted to the index, it can be imagined to be a significant event in terms of information, which is contrary to the assumptions of strong form efficiency (Fama 1970), according to which all information would already be visible in the stock price and even insider information should not give investor an advantage. Shleifer (1986) has written in his information hypothesis how new information when entering and receiving the market can lead to temporary inefficiency, which contradicts the EMH. Adding to this, Harris, and Gurel (1989) write in their Peer Pressure Hypotheses, emphasizing how the actions of others influence the behaviour of investors, which can lead to herding effects in listings or delisting's. The herding effect refers to how investors follow and copy what others do. As investors rush to adapt to these events, these phenomena (listing and delisting) can worsen the volatility of the events and the trading volume and lead to abnormal volumes or returns. Harris and Gurel (1986) also state that an increase in volumes is not always associated with an increase in the price of stock, and they may also not increase in connection with the listing.

When companies are removed or added to the index, it is not only a matter related to the company's visibility and perceived credit, but also the trading liquidity of the company's stock. Beneish and Whaley's (1996) study of liquidity effects highlights how changes in trading volumes during index reconstitutions can affect stock prices regardless of new information. This is important in connection with listings and delisting's, when trading increases and can lead to price pressures that are not in line with the true value of the company. Glosten and Milgrom's (1985) model complicates this further by showing how there is an information asymmetry between informed investors and uninformed investors. This can affect liquidity, spread, and can also affect the stock's volatility in connection with changes in the index. Similarly, Grossman and Stiglitz (1980) argued that stock market prices cannot be efficient as all the information held by informed traders is not incorporated to the stock prices. Their model suggests that there would be an equilibrium in the market, only if both informed and uniformed traders coexist. This highlights the paradox that if stock prices would reflect all the information, no one would be come an informed trader.

Efficient markets, information asymmetry and psychology between investors together form a complex market model that can be used to try to explain the effects of index listings or delisting's. While the EMH basically provides a basic theory, additions such as the Peer Pressure Hypothesis to liquidity provide a deeper understanding of the mechanisms that drive markets and their reactions.

1.2. Previous empirical research

Kasch and Sarkar (2012) studied the S&P 500 index and the related effect from the perspective of listings and found out that firms included in the index faced a huge increase in their earnings, market value and positive price effect in the preceding period of market inclusion. Elliot, Van Ness, Walker and Warr (2006) similarly backs this in their analysis of S&P 500 inclusion effect. Their study highlights that on average when stocks are added to the index, they earn abnormal returns on both inclusion date and announcement date. For abnormal returns on listings, and most important finding was increased investor awareness, which was the primary factor. Goetzmann and Garry (1986) researched S&P 500 in the other direction, what happens to stocks when delisted, and found out that there is a long term drop in the prices of delisted stock. This suggests that a negative price effect is associated with delisting event, which is controversial to the EMH stated in the previous chapter. Schleifer (1986) also found out on his information hypothesis that newly listed stocks on the index experience a positive effect on their stock price, which leads to abnormal returns in a short-term period after the listing. Listing and delisting liquidity in the S&P 500 was studied by Hedge and McDermott (2003), who found out that there was a sustained increase in the liquidity of stocks that were added to the index. On the other hand, liquidity for delisted companies declined over the next three months following the delisting. In the same context, Amihud and Mendelson (1986) argue that when stock liquidity increase, it will be positively correlated to firm's value, which means that stock price will increase.

To understand the intraday patterns in trading volumes and price variations, a study by Admati and Pfleider (1988) was made, which suggests that traders prefer specific trading times, and it is influenced by information releases and participation costs. This led to predictable fluctuations in trading volumes and volatility throughout the day. Odean (1998) studied the impact of trading volumes on stock prices, focusing on individual investors and found out that high trading volumes are often followed with negative abnormal returns. This suggests that individual investors tend to do trades more excessively and at inopportune times, which was based on overconfidence and led to lower returns for them.

More recent study by Ardiansyah, Handayani and Setyawati (2023) in the Indonesian stock exchange during the 2018-2021 period, suggest that there is a significant disparity on the abnormal returns before and after the rights issue. Controversially, stock volume levels did not see a significant disparity as it was argued with the statement that investors are reluctant on selling as they want to stand on their positions, which results on trading activity. A similar study in the

Indonesian Stock Exchange was conducted between 2013 and 2014 where Dewi and Zulfiah (2016) studied liquidity and abnormal returns before and after stock splits. Their findings where different compared to Ardiansyah, Handayani and Setyawati (2023) as there was no significant disparity on abnormal returns before or after the stock split event. To note, these studies are not the same, but are indicative.

1.3. Hypotheses development

Based on previous research and theory, this chapter deals with the formation of hypotheses aimed at investigating the effects of listing and delisting the Nasdaq-100 index. The focus is on abnormal returns and volumes, which have been chosen to evaluate deviations from the stocks' possible expected development.

Drawing from Shleifer's (1986) Information Hypothesis, it can be assumed that with the addition to the index, the shares will see a short-term increase in value, which can be understood as an abnormal return. The phenomenon can be explained as the market's positive reception of the listing event as an indicator of stock valuation. Conversely, it is expected that the delisting of the index will lead to a decline in the value of the stock, which can be seen in the negative form of an abnormal return (Hedge, McDermott, 2002). This study focuses only on the Nasdaq-100 index, the aim of which is to find possible market errors that deviate from the usual market forecasts in connection with listings and delisting's. The efficient market hypothesis is used as a basis for this analysis, as it states that stock prices are in line with all available information. If there are possible deviations, they can be read as cases of market inefficiency. Following hypotheses are proposed:

H1A: Companies experience positive abnormal returns after being listed on Nasdaq-100 index.

H1B: Companies experience negative abnormal returns after delisting from Nasdaq-100 index.

Echoing Hedge and McDermott (2003), that adding to an Index like the S&P 500 correlates with an increase in the liquidity levels of the shares. In this study, it is analysed through trading volumes. Highlighting the relevance of measuring volumes to predict stock prices returns and market dynamics as the idea is to have a liquid market where investors can sell and buy cheaply large amounts of stocks (O'Hara, 1995). Abnormal volumes are crucial for understanding how stocks are traded when examine the effects of listings and delisting in index like Nasdaq-100 since investors consider liquidity in formulating their portfolio strategies to avoid illiquid stocks (Dubofsky, Groth, 1984). Volume hypotheses are based on the idea that listing increases visibility and attraction in the market parallelling the findings to Hedge and McDermott (2003). Conversely, it is assumed that delisting has a reverse effect on volumes due to reduced investor interest. Following hypotheses are proposed:

H1C: Companies experience positive abnormal volumes after being listed on Nasdaq-100 index.

H1D: Companies experience negative abnormal volumes after delisting from Nasdaq-100 index.

2. DATA AND METHODOLOGY

This chapter includes sample and data selection, research methods, measurement of variables abnormal returns, cumulative abnormal returns, abnormal volumes, and finally possible limitations.

2.1. Sample and data selection

The Nasdaq-100 is an index that possess the hundred most extensive companies that are listed on the Nasdaq exchange. A listed company must be something other than a financial company and must be defined according to the Industry Classification Benchmark (ICB) defined by FTSE International Limited. To be listed in the index, the average daily volume of stocks must be more than 200,000 per day for the last three months. Primary criterion for inclusion is market capitalization as companies are ranked based on their market cap and those companies that rank in top 100 are eligible for inclusion in the Nasdaq-100 index. Typically, Nasdaq reviews their index in December when they hold their annual review, but adjustments are also done quarterly and on special occasions such as mergers and acquisitions or other corporate actions (Nasdaq-100 Index, pp. 6).

This study uses a 10-year period, starting from January 1, 2014, and ending on December 31, 2023. It was chosen because it includes many different economic cycles such as bull and bear markets and individual market disturbances but gives us a general and realistic picture of the decade's events and developments. The data is divided into two sections, listings, and delisting, which have been studied separately. The setting for this study is Nasdaq-100 index and stocks that were listed or delisted into.

During this period a total of 221 companies where delisted or listed to Nasdaq-100 index. From this data set, 111 companies where delisted and 110 companies were listed to the index. When screening data from Refinitive Eikon, companies that had been listed on the public stock exchange during the -125 to -5-day estimation window had to be removed, because there was not enough historical data prior to index listing. Companies that have made a stock split during the estimation period had to be excluded because the data is not consistent. Also, companies that had left the stock exchange in such cases as private equity purchases had to be excluded from the study due to insufficient data. Some of the listed and delisted companies which did not have the sufficient data for estimation period for unknown reason were also dropped. Since the research period is limited from January 1, 2014, to December 31, 2023, companies that have listed or delisted before June 23, 2014, were excluded because they were located within the -120 to -5 estimation window. Used estimation window was limited to banking days where stock exchange was open, so calculated days -125, -5, +5 do not include weekends or national holidays when the U.S stock exchange was closed. Link to the dataset will be in the appendix 1. Annual listings and delisting's are represented along with total observations in below in Table 1.

Table 1**.** Listings and delisting's observations

Year	Listings	Total Observations	Year	Delistings	Total Observations
2023	9	10	2023	8	10
2022	9	10	2022	9	10
2021	8	8	2021	5	9
2020	12	12	2020	11	13
2019	6	9	2019	6	11
2018	9	9	2018	5	12
2017	10	10	2017	8	11
2016	8	16	2016	3	15
2015	9	16	2015	6	17
2014	4	10	2014	2	3
Total	84	110	Total	63	111

Source: Author's compilation

With restrictions done, the data set was left with sufficient 84 companies that were listed and 63 companies that were delisted, totalling the number of companies to 147.

2.2. Research methodology

This study is based on the Peer Pressure hypothesis, Information hypothesis and efficient market hypothesis, which was reviewed earlier on chapter 1.1, according to which stock prices should be based on all the information available on the market. This will be investigated using the event study method, which is widely used in economic and financial studies in the short-term research (McKinlay, 1997). According to Holler (2014) event study window is typically 1 to 11 days and centres symmetrically around the event day. The selected event window is a critical period because during it the stock's development and possible effects of events, which in this study are listing and delisting, are monitored and analysed. For this research the event window is demarcated from four days before (T_{-4}) to five days after (T_{+5}) the listing or delisting event where the event date is formulated as $\tau = 0$. This event timeline was chosen as it is the most common number of days according to Oler, Harrison and Allen (2007), who concluded a study which resulted that 76,3% of the studies concluded a 5-day event window. As we study the prior and aftereffects around the event day, the recommended time will go on both ways, totalling the event window to 10-days.

Before the selected event window, an estimation window is established to measure the normal performance of the stock, which is not affected by the event. In this research the window spans from 125 days before the event (T_{-125}) to five days prior (T_{-5}). This period in the stock's history is used to model returns and volumes against which actual returns can be compared. Following the suggestion of McKinlay (1997), a 120-day estimation period has been implemented as it is the usual duration to obtain a balanced representative sample of trading that is not too far from the event. To focus on the market's pure reaction to listings and delisting's, the study assumes that transaction costs are zero. This assumption is derived from the theoretical work of Fama (1970), ensuring that trading costs do not interfere with the observed effects, so that the analysis of the study is more generalizable and fairer.

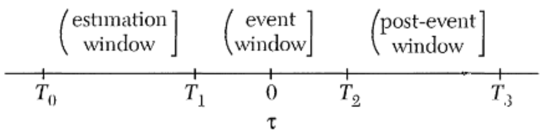

Figure 1. Event study timeline
Source: Mckinlay (1997)

In the attached illustration, a visual representation of the timeline of event study and the delineating estimation window (T_0 to T_1), event window (T_1 to T_2) and the post-event window (T_2 to T_3) which was not studied in this research. In this illustration τ is the day relative to the event, where $\tau = 0$ marking the event day.

To assess the statistical significance for abnormal returns (AR), cumulative abnormal returns (CAR), and abnormal volumes (AV), we rely on our significance testing to the t-test. Additionally, we calculate standard errors as it is crucial for tests to measure precision of estimated means. These are done through academicians Brown and Warner (1980), and Jain (1987) calculation methods where it is assumed firms for having normally distributed abnormal returns. Following the formula where single firm at each day τ is:

$$\tau_{AR_{i\tau}} = \frac{AR_{i\tau}}{\sigma(AR_i)} \tag{1}$$

where $\sigma(AR_i)$ is the standard deviation of every AR in the estimation window. From this it is possible the derivate the formula based on the estimated standard deviation of the event windows abnormal returns of each firm during the period T days as:

$$\sigma(AR_{i\tau}) = \sqrt{\frac{\sum_{\tau=1}^{T}(AR_{i\tau} - \overline{AR}_{i\tau})^2}{T-1}} \tag{2}$$

Abnormal volumes (AV) will be calculated in the same way as formulated above. T-statistics is also done with every CAR. Standard error is estimated for AR, CAR, and AV calculations by dividing their standard deviation by square root of number of firms. In order to draw conclusions from the research, statistical reliability is done at the levels of 1%, 5% and 10% to see if listing or delisting events have an effect on the stock's development. Statistically, it can be thought that a strong statistical significance from zero means that listing or delisting influences the stock. To test these, the following hypotheses can be generated for the research:

H0: The mean abnormal returns on a day $\tau = 0$
H1: The mean abnormal returns on a day $\tau \neq 0$

H0: The mean abnormal volumes on a day $\tau = 0$
H1: The mean abnormal volumes on a day $\tau \neq 0$

H0: The mean cumulative abnormal volumes on a day $\tau = 0$
H1: The mean cumulative abnormal volumes on a day $\tau \neq 0$

2.3. Measurement of Variables

The measurement of variables in this research has been made based on previous studies regarding abnormal returns, cumulative abnormal returns, and abnormal volumes. Possible limitation of information can affect the calculations.

2.3.1. Abnormal returns and market model

Abnormal returns are used in the event study method to see if there are any effects on listings and delisting's. Abnormal return refers to the difference between the actual return and the unanticipated return on the studied event window or day. Standard way to do this is to estimate first a market model for every single firm on the data set and then calculate abnormal returns. With this, abnormal returns are estimated to reflect market's reaction to the arrival of information or an event (McWilliams, Siegel, 1997). The rate of return on the traded stock of a firm is *i* on day *t* and the formula is expressed as:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it} \tag{3}$$

where:

$R_{it} =$ is the rate of return on the traded stock of a firm *i* on day *t*,

$\alpha_i =$ intercept of the regression equation,

$\beta_i =$ stock's sensitivity to market returns,

$R_{mt} =$ return of the market index at time *t*, which in this research is the Nasdaq-100 index,

$\epsilon_{it} =$ is the error term, where $E(\epsilon_{it}) = 0$

By deriving the above formula from McWilliams and Siegel (1997), we can now estimate daily abnormal returns (AR) for *i*th firm using the following formula:

$$AR_{it} = R_{it} - (\alpha_i + \beta_i R_{mt}) \tag{4}$$

where:

α_1 and β_1 are the ordinary least squares (OLS) parameters (Brown, Warner, 1985). Estimations were obtained from regressions of R_{it} on R_{mt} over an estimated period τ = -125 to τ = -5 days prior to the event. To calculate the OLS parameters for market model and every company *i* in the event window, we use the formula by McKinlay (1997), which can be formulated as:

$$\hat{\beta}_i = \frac{\sum_{\tau=T_0+1}^{T_1}(R_{i\tau}-\hat{\mu}_i)(R_{m\tau}-\hat{\mu}_{m\tau})}{\sum_{\tau=T_0+1}^{T_1}(R_{m\tau}-\hat{\mu}_m)^2}$$

$$\hat{\alpha}_i = \hat{\mu}_i - \hat{\beta}_i\hat{\mu}_m$$

$$\hat{\sigma}^2_{3_i} = \frac{1}{L_1 - 2} \sum_{\tau=T_0+1}^{T_1} (R_{i\tau} - \hat{\alpha}_i - \hat{\beta}_i R_{m\tau})^2$$

where:

$$\hat{\mu}_i = \frac{1}{L_1} \sum_{\tau=T_0+1}^{T_1} R_{i\tau}$$

$$\hat{\mu}_m = \frac{1}{L_1} \sum_{\tau=T_0+1}^{T_1} R_{m\tau}.$$

According to McWilliams and Siegel (1997), the abnormal returns (AR_{it}) represent the returns that were earned after the calculations were adjusted for the normal level of expected returns. Significant difference can be seen to be an abnormal return. In order to get the arithmetic, mean of abnormal return $(AR_{N\tau})$ for each τ of the studied period, the formula must be derived so that it is divided by *N*, which is the total number of companies studied (Pettersson, 1989). The following equation can be formulated as:

$$AR_{N\tau} = (1/N) \sum_{i=1}^{N} AR_{i\tau} \tag{5}$$

2.3.2. Cumulative abnormal returns

In this research cumulative abnormal returns (CAR) are used as a tool to analyse how studied events impact stock prices. CAR is used to measure any separate movements on listing or delisting compared to normal predicted market movements. It is also used measure whether these events produce significant abnormal returns or losses and how that affects the liquidity of the stock. According to Petterson (1989), CAR can be calculated by:

$$CAR_{Nn} = \sum_{\tau=T_1}^{T_2} AR_{N\tau} \tag{6}$$

where:

CAR_{Nn} = is the cumulative abnormal return for N securities for a period of length n, which is the event study window

$AR_{N\tau}$ = arithmetic means of AR_{it}

T_1 = First period when $AR_{N\tau}$ are accumulated

T_2 = Last period when $AR_{N\tau}$ are accumulated.

To calculate the mean cumulative abnormal returns ($\overline{CAR}_{N\tau}$) for our every estimated τ in the event window, it must be divided by N, which is the number of observations (Pettersson, 1989). Following formula can be as:

$$CAR_{N\tau} = (1/N) \sum_{i=1}^{N} CAR_{Nn} \quad (7)$$

2.3.3. Abnormal volumes

Abnormal volumes refer to trading that deviates significantly from the normal, expected performance of a particular stock over a period. To quantify abnormal volumes, we establish a baseline for average ratio. After this, we can calculate the expected volumes to identify if actual trading volume significantly exceeds or falls short of our baseline average. To calculate abnormal volumes ($V_{i\tau}$) where *i* = firm and τ = day, $S_{i\tau}$ = outstanding number of shares for *i* on the trading day, $n_{i\tau}$ = volume of traded share for *i* on day τ ,following formula by Campbell and Wasley (1996) is used:

$$V_{it} = \log\left(\frac{n_{i\tau} \cdot 100}{S_{i\tau}}\right) + 0{,}000255 \quad (8)$$

The constant 0,000255 is added to avoid a log transformation of zero, if the number of trades in each day would be zero. This constant was recommended by Cready and Ramanan (1991). To calculate the daily abnormal volumes ($AV_{i\tau}$), we derive the formula as:

$$AV_{it} = V_{it} - \bar{V}_i \quad (9)$$

with

$$\bar{V}_i = \frac{1}{T} \sum_{t=f}^{I} V_{it} \quad (10)$$

where V_{it} is the log transferred dollar volumes for stock *i* for day τ (Liden, 2007) and $\bar{V}_i$ is the mean of volumes in the estimation period. T stands for the number of days in the estimation period, where f is the first day and I is the last day of the estimation period. To calculate the mean abnormal volumes ($\overline{AV}_\tau$) for the day τ, we divide it by N, which stands for the number of observations during the day.

2.3.4. Possible limitations

The choice of event window -4 to +5 shows for us the direct and immediate effects in the market. However, it may take longer for the market to adapt to the listing and delisting effects, which might distort the studied event window. The possible overlap of events in the research period can be distorting, as it does not give the opportunity to study the effect of individual events. This research was made to see short term liquidity and abnormal returns, but the event window could be longer to see a wider and further picture. Although the -120-day estimation window is standard, it simply assumes that the market environment is stable during this period. Significant events in the estimation period can distort the metrics used and might not fully account for all market dynamics or company specific factors which might lead to potential biases in the results. To balance these effects, the estimation window could be longer, such as a year.

Abnormal volume method is a widely used measure in the financial world, however it does not tell for example other levels in liquidity such as market depth or bid-ask spread. Different liquidity measures might yield varied results. Times of high volatility can affect individual shares differently in listing and delisting events, which makes it challenging to completely isolate the event time. The economic environment, regulatory changes or other significant global events during the event period may affect the market's reaction. Abnormal volume measures are calculated on a daily basis so subtle intraday effects could be missed, if compared to high-frequency (tick) data.

While Refinitive Eikon is a reputable source, no database is immune to errors. There may be possible false values on some individual days. This can affect the calculations of abnormal returns and abnormal volumes. The collection, storage, and output of data in Refinitive Eikon may have changed in the last ten years, which may cause small differences with the data at the beginning and end of the ten-year research period. There may be differences in the depth and breadth of the collected data between different markets, but this is less of a problem in the Nasdaq-100 index as it is the target of this research. On the other hand, it may affect the comparative analysis between, for example, different marketplaces.

3. ANALYSIS AND DISCUSSION

In this chapter, the findings are discussed regarding the impact of listings and delisting's on the Nasdaq-100 index from 2014 to 2023. Robustness check will be done for both events. Starting with an analysis of the listing events, followed by an analysis of the delisting's, robustness check and lastly discussions regarding the findings and their comparison with previous studies and literature.

3.1. Listings

The given tables and figure 2. show the behaviour of stocks around the index listing event. Mean abnormal return (AR_{Nt}), mean cumulative abnormal return ($\overline{CAR}$), and mean abnormal volumes ($\overline{AV}$) are analysed to see how the market reacts to the chosen event.

Table 2. Listings AR, CAR and AV

τ	Mean AR	t-stat	Mean CAR	t-stat	Mean AV	t-stat
-4	-0,06%	-0,223	-0,06%	-0,223	0,275	5,657*
-3	0,26%	1,270	0,20%	1,183	0,322	6,853*
-2	0,07%	0,247	0,27%	1,850***	0,390	8,976*
-1	-0,04%	-0,118	0,23%	1,698***	2,053	28,567*
0	-0,42%	-1,542	-0,19%	-1,579	0,309	6,455*
1	-0,13%	-0,574	-0,32%	-2,994*	0,148	2,315**
2	-0,37%	-2,269**	-0,70%	-7,284*	-0,010	-0,178
3	-0,30%	-1,574	-1,00%	-11,427*	-0,127	-1.862***
4	-0,22%	-0,832	-1,22%	-14,698*	-0,076	-1.374
5	-0,21%	-1,062	-1,43%	-18,542*	-0,149	-2,846*
Significant at 1% (*), 5% (**), 10% (***)						

Source: Author's calculations

The results presented in the table provide a broad picture of the market's reaction in the transaction window between $\tau = -4$ to $\tau = 5$. AR_{Nt} starting from $\tau = -4$ shows practically negligible changes from expected returns. AR_{Nt} increases slightly, but not to significantly exceed when $\tau = -3$. Approaching the event date ($\tau = 0$), a negative spike can be observed. This trend extends to the time after the event. AR_{Nt} does not differ significantly from zero until $\tau = 2$, where the AR_{Nt} (-0.37%) is significant at the 5% level. It is worthy note that after this day, the market behaves abnormally.

When looking at the $\overline{AV}$, statistically significant abnormal volumes can be seen on the day of the event. In the days before the event date, there are significant abnormal volumes, especially $\tau = -1$, where t-statistic is 28,567 and statistically significant at the 1% level.

To understand the results, AR_{Nt} and $\overline{AV}$ statistical significance must be looked up to. This way it is easier to understand the reaction on new listings in the Nasdaq-100 index. Although $\tau = 0$ does not indicate significant AR_{Nt}, it does indicate that $\overline{AV}$'s are significant. The data suggests also that the period around the event day is statistically significant on $\overline{CAR}$ and $\overline{AV}$. The negative trend on $\overline{CAR}$ and positive abnormal trading volumes before the event suggest that the market is changing its valuation for the upcoming stocks that are listed.

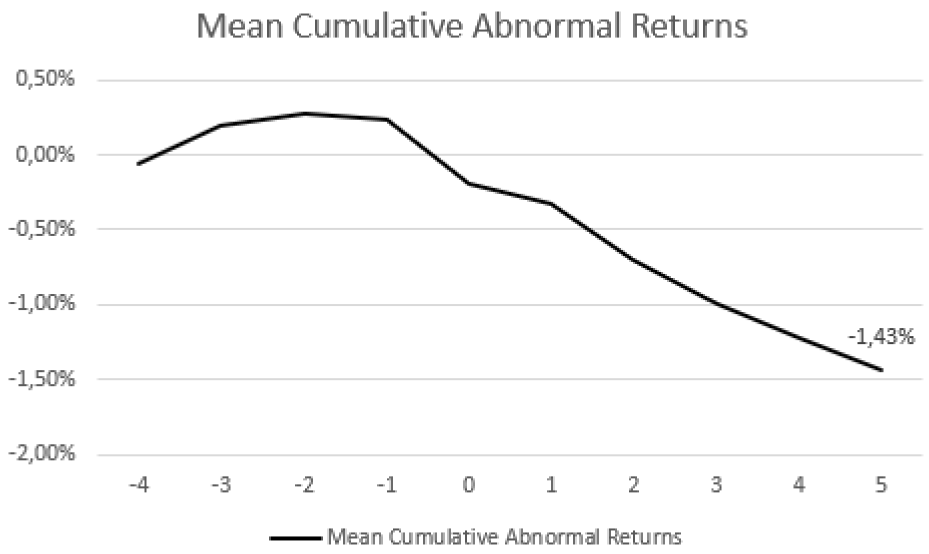

Figure 2. Mean CAR on stock listings
Source: Author's calculations

Interesting finding in this study is the development of $\overline{CAR}$ on the day of the event and after. There is no statistically significant abnormal behaviour on the event day itself, but it marks the beginning of a negative trend. After the event date, the $\overline{CAR}$ accelerate downward and registers significant negative returns with values $\tau = 1$, to $\tau = 5$ where every t-statistic is significant on a 1% level. With this information, it seems that the market is adapting to a phase where new information is fully absorbed and reflected in stock prices. During the entire event window period, $\overline{CAR}$ tally to -1.43%. With the t-statistic on the last day being -18.542 and statistically significant.

Table 3: Descriptive statistics CAR on listings

Variables	Mean	Median	Std. Dev	Min	Max	T-test
Mean CAR (-4,0)	0,09%	0,20%	0,00204	-0,19%	0,27%	-0,313
Mean CAR (-1,1)	-0,10%	-0,19%	0,00290	-0,32%	0,23%	-1,213
Mean CAR (0,1)	-0,26%	-0,26%	0,00093	-0,32%	-0,19%	-1,147
Mean CAR (0,5)	-0,81%	-0,85%	0,00494	-1,43%	-0,19%	-3,145*
Significant at 1% (*), 5% (**), 10% (***)						

Source: Author's calculations

The table above shows the $\overline{CAR}$ in different time intervals around the event date $\tau = 0$. Interpreting $\overline{CAR}(-4{,}0)$, mean is 0.09% and a median 0.20%. These suggest a modest positive correction before the event. As the standard deviation is low at 0.00204, it shows that there is little variation in returns during this time frame. This may suggest a little positive optimism among investors. At $\overline{CAR}(-1{,}1)$, the mean and median drop to negative figures of -0.10% and -0.19%. This suggests that optimism is waning, and investors are reassessing their position. As the standard deviation increases to 0.00290, it indicates greater uncertainty or variation in investor preferences. $\overline{CAR}(0{,}1)$ mean and median have continued to decrease and is in line with the negative trend of previous statistics. The low standard deviation of 0.00093 shows that the market reacts uniformly, which reflects a collective interpretation of the listing. The min and max range here is the smallest of all, which means that the market is unanimous. The post-event $\overline{CAR}(0{,}5)$ shows a clear drop in the mean and median, which are -0.81% and -0.85%. A significant decrease and change indicate that investors have changed their valuation negatively because of the listing.

3.2. Delistings

Similarly to listings on chapter 3.1, the given table below shows the behaviour on stocks around the delisting event day. AR_{Nt}, $\overline{CAR}$ and $\overline{AV}$ are also shown here from $\tau = -4$ to $\tau = 5$ to analyse the delisting effects. T-statistics are also shown for relative days and significance levels.

Table 4. Delisting's AR, CAR and AV

τ	Mean AR	t-stat	Mean CAR	t-stat	Mean AV	t-stat
-4	0,21%	0,639	0,21%	0,641	0,243	5,297*
-3	0,69%	2,170**	0,90%	4,016*	0,213	3,974*
-2	0,14%	0,243	1,04%	4,407*	0,399	4,902*
-1	0,62%	1,622	1,66%	8,268*	1,923	26,284*
0	0,55%	1,423	2,21%	12,419*	0,216	3,480*
1	0,49%	1,591	2,70%	17,219*	-0,067	-0,906
2	-0,32%	-0,981	2,38%	16,689*	-0,080	-1,212
3	0,81%	4,173*	3,18%	25,054*	-0,271	-3,238*
4	-0,08%	-0,288	3,11%	26,567*	-0,234	-3,342*
5	0,69%	2,200**	3,80%	34,567*	-0,181	-2,730*
Significant at 1% (*), 5% (**), 10% (***)						

Source: Author's calculations

Looking at the period before the event date $\tau = -4$ to $\tau = -1$, AR_{Nt} is statistically insignificant except for $\tau = -3$ when it is significant at the 5% level. This suggests that investors are not yet reacting to the future delisting event. $\overline{AV}$ starts to show abnormal levels immediately at $\tau = -4$ and is significant at 1% level, which shows that trading activity increases even before the actual listing. On the listing day, AR_{Nt} is 0.55%, but it is not statistically significant. On the other hand, $\overline{CAR}$ is already 2.21% and significant at the 1% level, which makes this interesting. $\overline{AV}$ on the listing day is not significantly higher compared to previous days, which shows that the number of trades does not differ significantly. However, the number of trades jumps before the delisting day when the t-statistic is 26,284. This indicates that investors know how to expect something to happen to the stocks in question. AR_{Nt}s after the event day gives a mixed pattern and not all days are statistically significant. $\overline{AV}$ after event date is not consistent for statistical significance. This shows that the removal does not consistently affect trading, although it does affect the stock price.

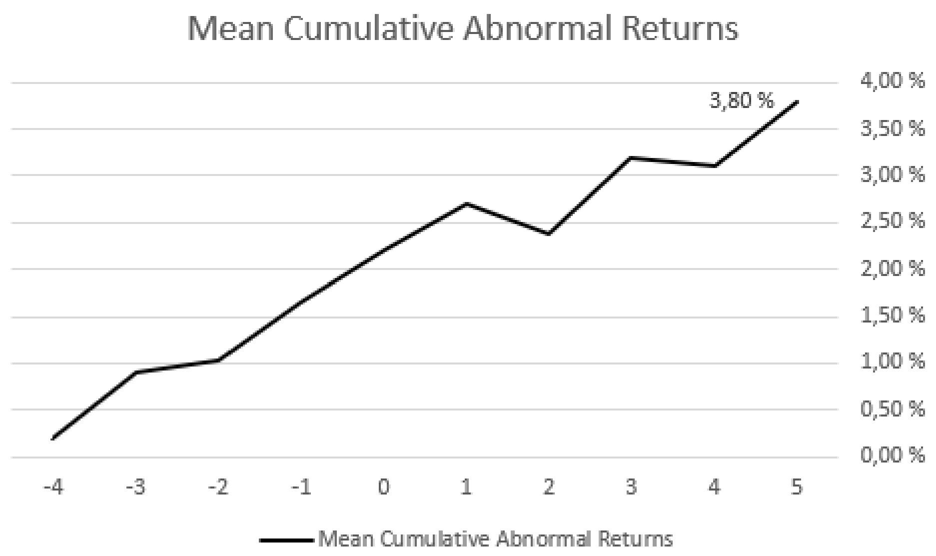

Figure 3. Mean CAR on stock delisting's
Source: Author's calculations

$\overline{CAR}$ continues to rise against expectations and culminates in a 3.8% rise on the last day $\tau = 5$. The t-statistic also clearly exceeds statistical significance for this day. This clearly shows a positive market reaction to delisting from the index. The positive continuation may reflect market sentiments, as investors may be relieved that underperforming stocks are removed from the index. Elevated t-statistic values for $\overline{CAR}$ after the delisting show that the market reacts and are statistically significant.

Table 5. Descriptive statistics CAR delisting's

Variables	Mean	Median	Std. Dev	Min	Max	T-test
Mean CAR (-4,0)	1,20%	1,04%	0,00765	0,21%	2,21%	3,095***
Mean CAR (-1,1)	2,19%	2,19%	0,00519	1,66%	2,70%	2,654***
Mean CAR (0,1)	2,46%	2,46%	0,00344	2,21%	2,70%	2,472**
Mean CAR (0,5)	2,90%	2,90%	0,00585	2,21%	3,80%	3,731***
Significant at 1% (*), 5% (**), 10% (***)						

Source: Author's calculations

This table describes $\overline{CAR}$ events and developments in delisting events. In the period $\overline{CAR}$ (-4,0), mean is 1.20% and median 1.04%. The proximity of these to each other indicates that the $\overline{CAR}$ is distributed symmetrically during this period. The small standard deviation of 0.00765 also shows that the numbers are not widely deviated from the mean. This partly shows that investors are starting to price their expectations regarding delisting, and there is a consensus on the market about the price development, as the range between min and max is also narrow. Approaching the event date, $\overline{CAR}(-1,1)$ mean rises to 2.19% and is perfectly in line with the median. This shows a very symmetrical distribution of returns and a strong consensus in the market among investors. With the minimum value increasing to 1.66%, it suggests that the unfavourable result expected by investors is still quite positive. The $\overline{CAR}$ $(0,1)$ mean already rises to 2.46% and is still in line with the median. The min and max of the range are relatively small, which shows that even the most cautious investors estimate the event to have a positive outcome. The period after the event $\overline{CAR}(0,5)$ reaches the mean of 2.90% and is again in line with the median. This indicates a positive reaction in the event. The fluctuation range widens between 2.21% and 3.80%, which indicates that the market has experienced the event as positive and sees the positive development continuing.

3.3. Robustness check

The given robustness check tables contain the firms of the analysed data, which are divided to sector. The purpose of robustness check is to ensure that the obtained results are consistent under different conditions and assumptions and do not result from a specific method that has been used.

Table 6. Listings robustness check

Sector	N	Mean CAR (-4,5)	t-stat
Consumer Discretionary	20	-3,915%	-24,342*
Telecommunications	3	-0,091%	-0,217
Industrials	6	-1,207%	-6,162*
Technology	36	-0,487%	-4,279*
Finance	3	-1,637%	-10,796*
Healthcare	8	-0,276%	-0,666
Utilities	3	-0,580%	-3,138*
Consumer staples	4	-3,259%	-19,152*
Energy	1	4,778%	7,232*
Significant at 1% (*), 5% (**), 10% (***)			

Source: Author's calculations

The Consumer Discretionary sector has a significant negative -3.915% $\overline{CAR}$. Its high t-statistic suggests that as a sector it experiences strong negative market reactions to index listings. Statistical significance shows that this is not a coincidence or a random event and may reflect the general opinion of the market. This may be due to the sector's sensitivity to cyclical fluctuations. Largest sample is the technology sector, where N = 36, has the lowest $\overline{CAR}$ of all and only -0.487% at a significant 1% level. This may indicate that listing events are not associated with negative returns as strongly as in the consumer discretionary sector. The figures show stronger confidence in the technology sector, even though the listing produces negative returns. In the financial sector, a negative $\overline{CAR}$ can be reflected in the regulatory environment of today's world and prove to be a sensitivity to market conditions. Significant positive returns in the energy sector may indicate market instability or sector-specific factors, but this requires further investigation as the sample is only one company.

When comparing the behaviour of the market sectors to the listing, it can be observed that the reactions of the sectors are negative and in line with the general result. This may indicate that the market sees an addition to the index as a signal of overvaluation or future underperformance. The reliable and high t-statistics in listings emphasize that the obtained $\overline{CAR}$ results are not coincidences.

Table 7. Delistings robustness check

Sector	N	Mean CAR (-4,5)	t-stat
Consumer Discretionary	24	1,742%	7,489*
Telecommunications	4	7,025%	13,760*
Industrials	4	3,422%	21,400*
Technology	20	5,416%	35,719*
Finance	4	2,840%	10,591*
Healthcare	7	5,137%	19,005*
Significant at 1% (*), 5% (**), 10% (***)			

Source: Author’s calculations

In delisting events, the telecommunications sector shows a high $\overline{CAR}$ value with 7,025% and its t-statistic is significant at the 1% level. This reaction may indicate that the market thinks the removal of this sector is beneficial and investors are reassessing the company's valuation. Investors also estimate that delisting in the technology sector is a positive thing and welcome to the market. A high t-statistic with a 1% valuation shows that this behaviour is not a coincidence. In delisting’s data, the t-statistic of all sectors are significant, so the obtained result is reliable. The data obtained by sectors is in line with the general result on delisting’s.

Robustness check confirms that general market reactions to listing and delisting observations are not abnormal but consistent across sectors.

3.4. Discussion

The findings of the empirical study of the listings and delisting's analysis show the dynamics of the market in relation to the theories of section 1.1. Although according to the EMH, all available information should be reflected in stock prices, abnormal returns and volumes between the event date suggest that the market does not immediately adapt to new information. The findings support the semi-strong form of the EMH, where valuation levels meet but with a delay, making the market momentarily inefficient (Fama 1970).

The obtained results are also in line with the Information Hypothesis (Shleifer, 1986), which shows that new information such as index changes can cause temporary inefficiency in the market. For example, according to hypothesis H1A, it was assumed that companies would experience positive abnormal returns in connection with listing, but the findings show that the market does not reward listing after all and is inverse, giving negative abnormal returns in connection with listing. On the other hand, hypothesis H1B according to which companies experience negative abnormal returns from the delist index saw positive abnormal returns. The market may feel that it is a good thing to remove weaker stocks. Peer Pressure Hypothesis by Harris and Gurel (1986) is good for explaining herding behaviour around the analysed events. In anticipation of a listing, investors may adjust their portfolios and the market will be in line with this. This may contribute to the unusual spikes and volumes that have been observed. In addition, according to the hypothesis H1C, it was assumed that in connection with the listing, companies experience positive abnormal volumes, but this was not the case, the volumes turned down and were smaller than expected. Hypothesis H1D's expectation of negative abnormal volumes experienced in connection with delisting was correct, as volumes decreased considerably after the listing, which can possibly be explained by the loss of investor interest.

This behaviour highlights the complexity of market psychology and its impact on valuation levels and goes beyond the simple predictions of the EMH. When comparing the results with the reviewed literature, there are similarities but also contradictions in the results. The findings of negative returns from listings are in line with Harris and Gurel (1986), according to which listings do not always lead to positive price pressures. In the delisting's analysis, the positive returns are contrary to typical expectations. This is in line with Beneish and Whaley's (1996) research, where index reconstruction can lead to improved market efficiency.

The results obtained from this study are very interesting for portfolio managers. Current investment strategies may need to be reconsidered. The findings from listings and the fact that listing on the Index does not consistently lead to positive market reactions challenge the traditional ideas that listing would naturally be good for the stock's development. Instead, the results favour a more cautious and wait-and-see approach to listing-related investments. By understanding this, it allows portfolio managers to minimize risk and potentially also take advantage of market adjustment time after listings.

The surprisingly positive market reactions to delisting's offer a unique investment opportunity. Delisting, traditionally seen as a negative thing, was indeed positive in terms of returns and suggests that the market sees the event as a possible cleaning mechanism that removes low-performing stocks and enables an index of strong performers. This view encourages investors and portfolio managers to reassess their strategies for stocks under threat of delisting. Keeping or even increasing the weight of the stock in these companies can produce positive results.

This study had limitations as it primarily focuses on short-term market reactions within a 10-day time window. With such a narrow time frame, it may not cover or show long-term economic effects, which can provide a different perspective on the extent and durability of observed market reactions. Future studies on the same topic may extend the period of analysis to a longer time frame to obtain a more comprehensive picture of the lasting effects of these events. In addition, macroeconomic factors and global market conditions should be considered to understand deeper insights and the persistence of effects in changes in economic cycles.

The methodology used in the research was quantitative and focused on measurable data on changes in the Nasdaq-100 index. Although this approach is valuable in terms of empirical evidence, it nevertheless limits intrinsic issues to the underlying issues of investors, such as motivation and emotional reactions, which can also be studied. These are important in understanding market dynamics. In-depth interviews with investors, investor communication analyzes and opinion surveys could complement this research and show the cognitive factors that guide investors' behaviour. This approach could increase the versatility and applicability of the observations, offering a more comprehensive picture of how investors behave in connection with index changes.

CONCLUSION

The purpose of this research was to investigate and analyse the market's immediate reactions to listings and delisting’s in the nasdaq-100 Index and to investigate whether these events cause abnormal returns or trading volumes. The research was guided by the theories of the efficient market hypothesis, the Information Hypothesis, and the Peer Pressure Hypothesis. The aim of these was to provide an empirical framework for research, to examine the impact of events on stock development and market behaviour in the short term.

All the four hypotheses to understand our research were based on the research question *“How do stock performance and volumes change for companies before and after being listed or delisted from the Nasdaq-100 index, and does this lead to positive (negative) abnormal returns or volumes?”* Hypotheses were created based on the theoretical framework and previous studies.

The first hypothesis “*Companies experience positive abnormal returns after being listed on Nasdaq-100 index”* will be rejected as listing to the Nasdaq-100 index did not lead to positive abnormal returns but gave negative returns which were statistically significant. Second hypothesis “*Companies experience negative abnormal returns after delisting from Nasdaq-100 index”* is also going to be rejected as delisting event led to statistically significant positive abnormal returns. The results of both hypotheses contradict previous studies.

Third hypothesis “*Companies experience positive abnormal volumes after being listed on Nasdaq-100 index”* will be rejected as the results showed negative abnormal volumes after the listing event. Fourth hypothesis *“Companies experience negative abnormal volumes after delisting from Nasdaq-100 index”* cannot be rejected as the results showed negative abnormal results for majority of the days after the delisting event which were statistically significant.

The obtained results offer a critical re-evaluation of the efficiency of traditional markets. The acceptance or rejection of the hypotheses show that markets do not always react efficiently or predictably to known events. This challenges the EMH. However, the findings are in line with the Information Hypothesis and the Peer Pressure Hypothesis, which shows that investors' behaviour can be influenced by the spread of information. This leads to herding effects that disturb the balance of the market. The results obtained in this study highlight the unpredictable nature of the market and the demand for the use of more sophisticated analytical tools. A deeper understanding is needed to better predict changes in the nasdaq-100 index. Comparative studies of different indices or continents could determine whether the phenomena observed in these studies are unique only to the Nasdaq-100 index, or whether this reflects a general pattern of global markets.

In conclusion, it can be stated that this study opens complex market reactions to the formation of the Nasdaq-100 index. The findings challenge existing theories and their adequacy in fully understanding market dynamics. In the context of index changes, this is emphasized and indicates the need for wider academic research.

LIST OF REFERENCES

Admati, A. R., Pfleider, P., (1988). A Theory of Intraday Patterns: Volume and Price Variability. *The Review of Financial Studies, 1(1)*, 3-40.

Amihud, Y., Mendelson, H., (1986). Asset pricing and the bid-ask spread. *Journal of Financial Economics, 17(2),* 223-249.

Ardiansyah, R., Handayani, K., Setyawati, D., (2023). Analysis of Differences in Abnormal Return and Stock Liquidity Before and After the Rights Issue. *Proceedings of the 20th International Symposium on Management (INSYMA 2023),* 68-73.

Beneish, M. D., Whaley, R. E., (1996). An Anatomy of the 'S&P Game': The Effects of Changing the Rules. *Journal of Finance, 51(5),* p1909-1930

Brealey, R. A., Myers, S. C., Allen, F. (2011). Principles of Corporate Finance. *Tenth Edition,* p333.

Brown, S. J., Warner, J. B., (1985). Using Daily Stock Returns: The Case of Event Studies. *Journal of Financial Economics, 14*, 3-31

Brown, S., Warner, J. B., (1980). Measuring Security Price Performance. *Journal of Financial Economics, 8(3)*, 205-258.

Campbell, C. J., Wasley, C. E., (1996). Measuring Abnormal Daily Trading Volumes for Samples of NYSE/ASE and NASDAQ Securities Using Parametric and Nonparametric Test Statistics. *Review of Quantitative Finance and Accounting, 6(3),* 26-309

Cready, W. M., Ramanan, R., (1991). The power of tests employing log-transformed volume in detecting abnormal trading. *Journal of Accounting and Economics, 14(2),* 203-2014

Dewi, A. S., Zulfiah, A., (2016). Comparative Analysis of Liquidity and Abnormal Returns Before and After Stock Split (Case Study on the Company Taking Stock Split Period 2013-2014). *The 7th Collaboration for Business in Technology and Information Industries 2016.* 249-256

Dubofsky, D. A., Groth. J. C., (1984). Exchange Listing and Stock Liquidity. *Journal of Financial Research, 7(4),* 291-302

Elliot, W. B., Van Ness, B. F., Walker, M. D., Warr, R. S., (2006). What Drives the S&P 500 Inclusion Effect? An Analytical Survey. *Financial Management, 35(4),* 31-48

Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance,* 25(2), p383. https://www.jstor.org/stable/2325486?seq=1

Glosten, L. R., Milgrom, P. R., (1985). Bid, ask and transaction prices in a specialist market with heterogeneously informed traders. *Journal of Financial Economics, 14(1),* 71-100.

Goetzmann, W. N., Garry, M., (1986) Does Delisting from the S&P 500 Affect Stock Price? *Financial Analyst Journal, 42(2),* 64-69.

Grossman, S. J., Stiglitz, J. E., (1980). On the Impossibility o Informationally Efficient Markets. *The American Economic Review, 70(3*), 393-408.

Harris, L., Gurel, E., (1986). Price and Volume Effects Associated with Changes in the S&P 500 List: New Evidence for the Existence of Price Pressures. *Journal of Finance, 41(4),* p815-829

Hedge, S. P., McDermott, J. B., (2003). The liquidity effects of revision to the S&P 500 index: an empirical analysis. *Journal of Financial Markets, 6(3),* p413-459

Holler, J. (2014). Event-study methodology and statistical significance. *Germany: O1WIR Publisher for Economics, Computer Science and Law.*

Jain, P. C., (1987). The Effect on Stock Price of Inclusion in or Exclusion from the S&P 500. *Financial Analysts Journal, 43(1),* 58-65.

Jensen, M. C. (1968). The Performance of Mutual Funds in the Period 1945-1964. *The Journal of Finance,* 23(2), 389-416

Kasch, M., Sarkar, A., (2012). Is there an S&P 500 Index Effect? *Federal Reserve Bank of New York Staff Reports, 484.*

Liden, E. R., (2007). Swedish Stock Recommendations: Information Content or Price Pressure? *Multinational Financial Journal, 11(3/4),* 253-285

McKinlay, C. A., (1997). Event Studies in Economics and Finance. *Journal of Economic literature. 35(1),* 13-39

McWilliams, A., Siegel, D., (1997). Event Studies in Management Research: Theoretical and Empirical Issues. *The Academy of Management Journal, 40(3),* 626-657

Nasdaq-100 Index website: *Nasdaq-100 index Methodology.* (2021). Retrieved March 16, 2024. From https://www.nasdaq.com/solutions/nasdaq-100

O'Hara, M., (1995). *Market Microstructure Theory*. Blackwell Cambridge.

Odean, T., (1998). Volume, Price, and Profit When All Traders Are Above Average. *The Journal of Finance, 53(6),* 1887-1934.

Oler, D., Harrison, J. S., Allen, M. R., (2007). Over-interpretation of Short-Window Event Study Findings in Management Research: An Empirical Illustration.

Pettersson, P. P., (1989). Event Studies: A Review of Issues and Methodology. *Quarterly Journal of Business and Economics, 28(3),* 36-66

Samuelson, P. A. (1965). Proof That Properly Anticipated Prices Fluctuate Randomly. *Industrial Management Review, 6:2,* p41.

Shleifer, A., (1986). Do Demand Curves for Stocks Slope Down? *Journal of Finance. 41(3),* 579-590

Yasir, B. T., Mehwish, N., (2015). The Efficient Market Hypothesis: A Critical Review if the Literature. *The IUP Journal of Financial Risk Management,* 12(2), 48-63

APPENDICES

Appendix 1. Link to dataset

Dataset

Appendix 6. Non-exclusive licence

A non-exclusive licence for reproduction and publication of a graduation thesis[1]

I Eemeli Vertti Julius Niemelä

1. Grant Tallinn University of Technology free licence (non-exclusive licence) for my thesis Short term market reactions to Nasdaq-100 listings and delisting's in 2014-2023,

Supervised by Kalle Ahi,

1.1 to be reproduced for the purpose of preservation and electronic publication of the graduation thesis, incl. to be entered in the digital collection of the library of Tallinn University of Technology until expiry of the term of copyright;

1.2 to be published via the web of Tallinn University of Technology, incl. to be entered in the digital collection of the library of Tallinn University of Technology until expiry of the term of copyright.

2. I am aware that the author also retains the rights specified in clause 1 of the non-exclusive licence.

3. I confirm that granting the non-exclusive licence does not infringe other persons' intellectual property rights, the rights arising from the Personal Data Protection Act or rights arising from other legislation.

_________________ (9.5.2024)

[1] *The non-exclusive licence is not valid during the validity of access restriction indicated in the student's application for restriction on access to the graduation thesis that has been signed by the school's dean, except in case of the university's right to reproduce the thesis for preservation purposes only. If a graduation thesis is based on the joint creative activity of two or more persons and the co-author(s) has/have not granted, by the set deadline, the student defending his/her graduation thesis consent to reproduce and publish the graduation thesis in compliance with clauses 1.1 and 1.2 of the non-exclusive licence, the non-exclusive license shall not be valid for the period*