IS GORDON’S GROWTH MODEL USEFUL IN PREDICTING FUTURE STOCK PRICES?

A closer look of the usability in Nasdaq Helsinki

Lappeenranta–Lahti University of Technology LUT

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Examiner: University Lecturer Roman Stepanov

ABSTRACT

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Is Gordon's Growth model useful in predicting future stock prices, A closer look of the usability in Nasdaq Helsinki.

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36 pages, 6 figures, 7 tables and 6 appendices

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Keywords: Gordon's Growth model, stock price prediction, Nasdaq Helsinki.

A multitude of factors can affect stock prices, thus creating a need and a want for stock price prediction. Gordon's Growth model is a method that can be used to estimate future stock prices under certain assumptions, such as regular and constantly growing dividend rate. The aim of this study is to test Gordon's Growth models usability in Nasdaq Helsinki, whilst also challenging the assumptions and applying the model to irregular dividend payers. A comparison between predicted and actual stock prices as well as between irregular and regular dividend payers is conducted with T-tests assuming unequal variances.

The results from the study align with the previous studies discovering undervaluing and overvaluing of the stock prices, thus leading the model to be deemed not useful, at least when used alone. However, the study neither denies the usability as a basis for modified models.

TIIVISTELMÄ

Lappeenrannan–Lahden teknillinen yliopisto LUT

LUT-kauppakorkeakoulu

Kauppatieteet

Maria Tawaststjerna

Onko Gordonin kasvumalli hyödyllinen työkalu osakkeiden tulevien hintojen ennustamisessa, tarkempi katsaus Nasdaq Helsinkiin.

Kauppatieteiden kandidaatti -tutkielma

2023

36 sivua, 6 kuvaa, 7 taulukkoa ja 6 liitettä

Tarkastaja: Yliopisto-opettaja Roman Stepanov

Avainsanat: Gordonin kasvumalli, osakkeen hinnan ennustus, Nasdaq Helsinki.

Monet tekijät voivat vaikuttaa osakekursseihin, mikä luo tarpeen ja halun osakekurssien ennustamiselle. Gordonin kasvumalli on menetelmä, jolla voidaan arvioida tulevia osakekursseja huomioiden tietyt olettamukset: esim. säännöllisesti, jatkuvasti kasvavan osingon. Tämän tutkimuksen tavoitteena on testata Gordonin kasvumallin käytettävyyttä Nasdaq Helsingissä, samalla haastaa olettamukset ja soveltaa mallia myös epäsäännöllisiin osingonmaksajiin. Ennustettuja ja toteutuneita osakekursseja sekä epäsäännöllisiä ja säännöllisiä osingonmaksajia verrataan T-testeillä olettamalla epätasaiset vaihtelut.

Tutkimuksen tulokset ovat linjassa aiempien tutkimusten kanssa, joissa on havaittu osakehintojen ali- ja yliarvostusta, mikä johtaa siihen, että mallia ei pidetä hyödyllisenä ainakin yksinään käytettynä. Tutkimus ei kuitenkaan kiellä käytettävyyden hyödyllisyyttä muunneltujen mallien perustana.

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1 Introduction

Stock prices are a widely discussed and researched topic, as stakeholders usually compare the true stock price and the price in the market to decide whether to buy or sell. In simplicity, stock price is formed based on supply and demand which changes every time there's an information change (Hatta and Dwiyanto, 2012). Often investment-decisions are not only driven by numbers but also by events, thus influencing the stock market (Ding et al., 2014). Consequently, understanding the causes of fluctuations of stock prices and the power information holds is a part of stock prediction nowadays. Due to growing access to information and reliability on computers, stock prediction is more accessible for everyone. Mishkin (2016, 50) concludes the need for stock predictions in a psychological way: it is a rollercoaster of emotions, whether the emotions are positive or negative, and it is done because people aim to *"get rich – or poor – very quickly."* As stock prices are vulnerable to experience changes when facing political, economic, or international events (Kohara et al., 1997). For these reasons, there are a multitude of different financial models to use for stock prediction, all of them placing more value on different variables and, thus, giving contrasting predictions. Furthermore, for this reason knowing when to use a specific model is crucial for receiving arguable reliable results.

One of these tools is the Gordon's Growth model, also known as the Dividend Discount model or GGM as a shortened version. According to Yao (1997) Gordon's Growth model is the most widely used stock valuation method which places a significant amount of importance to the constant growth rate affecting the dividend. Before the presentation of the model in 1962, the research field accepted an assumption of the irrelevance of dividend policy regarding investments and corporation valuation (Gordon, 1962). After this the use of the model has been extended in many ways like Yao (1997) did by using the model as a basis for Trinomial dividend valuation model. However, yet studies using the Gordon's Growth model can be argued to be rather limited: there are studies where for example the previous empirical evidence is missing or comments on how latest literature lacks a broader discussion of the topic, there is even claims about how the model is forgotten by researchers (Resende, 2020; Halicki and Kwater, 2018). In their study Resende (2020) deems the empirical evidence of the accuracy of the Gordon's Growth model to be missing in a field of considerable size, the US stock market. Clearly there is room for further research testing the model.

1.1 Research aim and research questions

The purpose of this thesis is to test and evaluate if Gordon's Growth model is useful in predicting future stock prices of companies listed in Nasdaq Helsinki. The usability of the predictions Gordon's Growth model provides is done by using T-tests to examine the accuracy between the predicted stock prices compared to the actual stock prices. This thesis aims to achieve this goal by taking two groups of companies from Nasdaq Helsinki: one group of companies paying dividends regularly and one group of companies paying irregular dividends. Reason for dividing the companies into two groups is to test the usability of Gordon's Growth model separately for companies paying dividends regularly and irregularly. Lastly, a set of T-test is conducted to examine the difference between regular and irregular dividend payers.

By doing this, the aim is to bring forward a study contributing to the research of Gordon's Growth model in Nasdaq Helsinki and to possible lay ground for further research. This is the reason why the previous research of Gordon's Growth model itself is placed in the literature review section of this thesis. To examine the usefulness of Gordon's Growth model research questions were set in place. The thesis discusses and analyses some of the previous efforts as well as the advantages and disadvantages of Gordon's Growth model in the literature review to answer the main research question. The main research question is also investigated by examining the usability by comparing the actual and predicted prices and by conducting T-tests. Thus, the main research questions this thesis aims to answer is:

Question 1: *How accurate is Gordon's Growth model in predicting future stock prices in Nasdaq Helsinki?*

This thesis also has two sub-questions which it aims to answer by considering the calculations and results from the T-tests. The sub questions are placed to support answering the main research question, therefore, to aid the main research question the following are also considered:

Question 2: *Is there a statistically significant difference between stock price predictions provided by Gordon's Growth model and the actual stock prices?*

Question 3: *What is the difference between regular dividend payers and irregular dividend payers when applying Gordon's Growth model to them?*

1.2 Limitations

This study is limited to the Nasdaq Helsinki and to narrow and define the research first the years were selected from the past and current decade: the time frame of the study is years 2010-2022. The thesis is also limited to using ten companies in total, so five regular and five irregular dividend payers. The number of companies limits the possibility to apply the results on a larger scale, but it was chosen to examine whether the matter would provide further research possibilities and which directions would be good to prioritize in future studies.

1.4 Structure

This study is structured by dividing it to five different cohesive sections, starting with the introduction discussing the background and need for the study. This is followed by theoretical framework defining the formula of Gordon's Growth model and the terminology which is used. Literature review comes next taking a closer look to the strengths and weaknesses of the model, as well as analysing previous studies. Then the data and how it is utilized is presented, which is finally followed with the results of the examination together with the conclusion.

2 Theoretical framework

The theoretical framework discusses the basic formula of Gordon’s Growth model and define the variables used in the model. A crucial part of the model, dividends, is also defined in detail. Then the thesis takes a closer look of the efficient market hypothesis as well as the history of the stock market, as stock price prediction requires the existence of stock markets. By defining stock price prediction, whilst also presenting its history, the connection to Gordon’s Growth model is made clearer. In figure one the framework of the Gordon’s Growth model is presented. This is to tie together and to demonstrate the topic the research will discuss and to portray the connections in a clearer way.

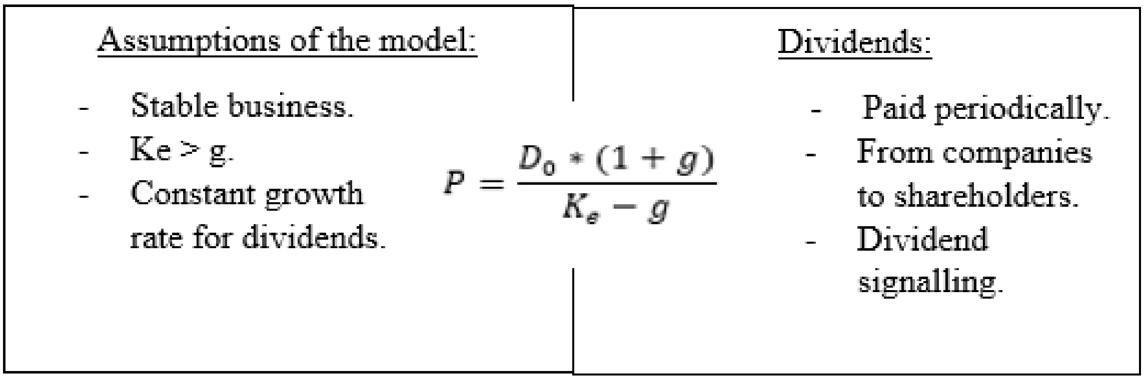

Figure 1. Structure of the theoretical framework

2.1 Gordon’s Growth model

Due to the popularity of Gordon’s Growth model and its role in developing the financial world, it has been researched as a method itself as well as it has appeared as a tool in various studies. Gordon’s Growth model is a take on valuation models, as the creator Myron J. Gordon himself thought that the already existing methods were not as useful as they could be. It is in this study where the author found the model to provide more valuable results than its predecessors. What differentiates this model from its predecessors it is its quality to function without assuming the future to be guaranteed and that by looking at the data available, the used parameters can be created. (Gordon, 1962; Halicki and Kwater, 2018)

As Resende (2020) and Mwangi (2017) demonstrate, the Gordon's Growth model and its variables are as following:

$$P = \frac{D_0 * (1 + g)}{K_e - g}$$

$$P = Current\ stock\ price$$

$$D_0 = Dividend$$

$$K_e = Cost\ of\ equity$$

$$g = Growth\ rate\ of\ the\ dividend$$

In Gordon's Growth model the cost of equity can for example be replaced with rate of return or the rate chosen to discount clash flows (Halicki and Kwater, 2018). However, this study will only use cost of equity. In this thesis all the variables in Gordon's Growth model will be annualised. Reason for this is to be able to generate stock predictions for each year. In this thesis, current stock price (P) will be the annual stock prices for the chosen companies for each year. Annual dividend (D) is taken from the chosen companies' websites as well as the cost of equity (Ke). Growth rate of the dividend (g) will be estimated later in this thesis.

2.1.1 Assumptions of Gordon's Growth model

The use of the model requires that certain assumption is considered about the dividends: the dividends are required to grow at a constant rate for an extended period (Mishkin, 2016, 188-189; Halicki and Kwater, 2018). To simplify the assumption, it can be said that the firm must be expected to be stable and not be headed toward bankruptcy. Halicki and Kwater (2018) have expressed some critique against the first assumption, as it disregards the conditions of the stock market and the value of the company. The authors go even as far as stating how it is not necessary to explain more in detail why the first assumption cannot be fulfilled in *"a real world that is variable and unpredictable"* (Halicki and Kwater, 2018, 40). This claim is also endorsed by the authors comment on the second assumption which can lead to extreme and unreliable stock valuations due to the sensitivity of the model. The second assumption is that cost of equity (or the rate of which is used to discount the cash flow or the rate of return) should be larger than the growth rate: $Ke > g$ (Resende, 2020; Halicki and Kwater, 2018). According to Ferguson (1998) there is no accurate way to conduct a long-term forecast of the dividends, also stating the prediction cannot be taken seriously. Due to this, Gordon's Growth model is a sensitive stock valuation method and the assumptions creating possible limitations in the reliability should be considered when using the results provided by the model.

2.1.2 Dividends

Dividends are cash payments from companies to their shareholders which are made periodically, and there is not one correct way companies should pay out dividends, however, there is a multitude of different theories about dividend payments research have come up with and the decision of the amount paid may affect the brand-imagine of a company (Mwangi, 2017; Mishkin, 2016, 187). Hence, dividends have been and still are very central topic when it comes to investing, and the basic principle of them is that a low share price most often means a higher dividend rate (B. Mark Smith, 2004, 113-114). Since dividends are a defining part of the Gordon's Growth model, the following definitions by Frankfurter, Wood, and Wansley (2003, 3-44) are to be considered: Earnings are the only source from where dividends can be paid to shareholders, all though when inflation has been high some companies have paid dividends in the form of a product instead of cash, and that some patterns in dividend payments have been recognized by previous studies, but this does not mean them to be predictable. However, Frankfurter, Wood, and Wansley (2003, 92-99) continue by explaining how dividends can also be seen as a tool to signal the value of a company to the market, as a higher dividend can be seen to summarize the value of the company in question. They argue that this way of communicating the value may be useful for companies where the amount of information to outside shareholders is limited – this way outside investors can assume the company to be doing well. Finally, the authors state, that the existence of dividend signalling cannot be denied, but the benefits and to whom they concern can and are argued.

As stated, depending on which dividend theory a company chooses to engage in may affect the brand-imagine of the company, which the value of the company can be argued to be a part of. Hence, it leaves to wonder whether there is a relationship between signalling theory and stock price predictions, to be more precise stock price predictions made with Gordon’s Growth model. As studies discussing Gordon’s Growth model can be argued to be limited, the uncertainty of the possible relationship between dividend signalling and the model can be a possible uncertain variable, of which the Gordon’s Growth model does not consider.

Dividends plat a significant role in this study as it has grouped companies from Nasdaq Helsinki into two groups: regular and irregular dividend payers. In this thesis irregular dividend payers are companies, that have chosen not to pay or that have been unable to pay dividends at least once during the period 2010-2022. However, it is to be noted that the companies chosen were chosen from still functioning and operating options. Consequently, the definition for regular dividend payers is companies that have paid dividends every single year after 2010 and that during the set time frame the dividend has experienced growth.

2.2 History of the stock market and definition of stock price prediction

Mishkin (2016, 49) defines stocks as a way for companies to fund their pursuits and ventures, and as a tool for investors to have assert ownership for a portion of the earnings and assets: stock market is defined as a place to trade the said assets and earnings. Since stock prediction would not be possible without the stock market itself, it is valuable to understand the history behind it. Stock market itself has been the subject for many studies especially after the second world war, however, this does not mean that stock market was invented in the 1940’s. One of the defining moments for the modern stock market happened already in 1609 due to the creations in Amsterdam when a new bank, Amsterdam Wisselbank, and a new company, The Dutch East India Company, started their work paving the way for the stock market we know today. It is due globalization that stock markets around the world were linked together. (B. Mark Smith, 2004, 6-16)

B. Mark Smith (2004) discusses globalization and its impact in his book, but the year it was published is to be considered, as it could be argued globalization has continued and contributed to the evolution of stock markets after the year 2004. A more recent study conducted in 2019 states that the global stock market has never been as financially unstable as it is now because of globalization and of the global financial integration (Bastidon et al., 2019). A very recent example of the financial instability is the COVID-19, which affected the stock market negatively as the stock market reacted rapidly to the new information causing damage to the global economy as stock markets experienced a decline and as the volatility increased (Şenol and Zeren, 2020; Fernandez-Perez et al., 2021).

The long age of the stock market cannot be denied and the changes it has experienced has led to the need and the want to try to predict and prepare for changes, thus nowadays there are multiple ways to predict stock prices and the methods in-use are constantly being reviewed, developed, and challenged also by machine learning. Instead of basing decisions on just the gut feeling, nowadays many tools and methods such as the linear regression, fundamental analysis, and statistics are used in stock prediction to help make the decisions more reliable, though not one method has proven to have certain success rate (Agrawal, Chourasia and Mittra, 2013). Stock price prediction is, by definition, taking chosen variables and events into account and trying to forecast what the stock price will be after a chosen amount of time has passed.

2.3 The efficient market hypothesis

This thesis uses historical stock prices as a part of predicting stock prices, which leads to the significance of the efficient market hypothesis. According to Hatta and Dwiyanto (2012) the efficient market hypothesis assumes markets to be efficient, when stock prices adjust themselves rapidly based on how new information affects supply and demand. The authors continue by stating that the markets experiencing information changes can be divided into three categories: weak form, semi strong form, and strong form - weak form being the one incorporating past changes in stock prices and thus being the most relevant to this thesis. In its original form, the weak form assesses how well past returns predict future returns. The existing theory was updated in 1991 by the author who first introduced the method, Eugen Fama. The updated version adds to the original by also including forecasting with dividend yields and interest rates (Fama, 1991).

In addition to taking the weak form into account, the semi strong form includes the reaction speed of security prices when public information is released. This category consists of event studies and the information they provide, to which stock prices seem to adjust in one day by average. The evidence proving fast reactions to events seems to be so widely accepted that studies do not use much time discussing it, it is rather noted that the reaction to events is efficient and them more pressing issues are discussed. Strong form is the same as previous ones, but it also takes into consideration any possible private information that may have been acquired. With private information it has been noted that there can be cases where markets are not fully efficient, meaning that the acquired private information is not reflected in the stock prices. Nevertheless, the insider information that is not reflected to the prices includes an assumption that all investors are still acting rationally. (Fama, 1991)

Efficient market hypothesis is discussed in this thesis, as according to it is impossible to predict future stock prices as they occur randomly (Olweny, 2011). In fact, according to Mishkin (2016, 197) public information such as recommendations cannot help anyone outperform the market, as the information is already reflected in the stock prices. Mishkin (2016, 197) continues by defining what randomly means; the stock price can either rise or fall, and that the change is unpredictable, and this theory of stock prices being unpredictable and random is called the random walk theory. This alone contradicts the accuracy of Gordon’s Growth model, as well as any prediction model’s capability to predict future stock prices.

3 Literature review

The history of stock market and the need for stock prediction was discussed as a part of the theoretical framework, thus the literature review will focus on the model itself, Gordon’s

Growth model. The structure of the literature review starts from a wider point of view focusing on history of the model and giving examples of different ways it has been used. Toward the end studies closer to stock prediction and stock valuation are discussed and tied together with this thesis by discussing the strengths and limitations of the model, while also telling the results of studies done in specific areas. The study done by Gordon (1962) is what started the popularity of the method, or at least laid grounds to it, and which works as a template for many future studies to come. And Gordon's Growth models' usability and functionality as a template for wider research was credited in a journal article where the author confirms different ways to modify the model to expand its usability. In the journal article done by Farrel (1985) one mentioned way was to use the modified model to estimate the sensitivity to interest rate risk. It is articles and studies like this which confirm how appreciated the model was even in its "early" days. The journal articles continue by praising the superiority of the model and its way to provide knowledge and insight about how risk factors and inflation rates affect stocks (Farrel, 1985).

3.1 Strengths and weaknesses of Gordon's Growth model

The reason for the popularity and longevity of the model is also speculated three decades later in a research paper discussing about the development of corporate performance measures. The paper refers to the simplicity of the model and even says it to be a tool for corporate valuation that is one of the most long-lasting, thus crediting the usability of the model (Garstka and Goetzmann, 1999). When speaking of corporate performance measures, Burinskas and Burinskiene (2020) demonstrated the practical results for companies when applying Gordon's Growth model to the Lithuanian transport sector. In addition, according to Belomyttseva and Grinkevich (2016), the main strengths of Gordon's Growth model lie in its ability to provide reliable results in stable industries and because of the way the use of dividends is more flexible compared to other options. Furthermore, the authors found out that the model is very suitable for up to 5 years for companies, which want to use it for research. Research has time and time again provided proof of the usability and functionality of the model. The model certainly has earned its respect. This all is not to say that the model has not been criticized when, in fact, the short comings of Gordon's Growth model have been researched.

According to a study conducted by Resende (2020) in this current century the model is not an accurate tool for US stock valuation. Agosto, Mainini and Moretto (2018) note that one common critique about the model is its inability to value companies not paying dividend. The study conducted by Agosto, Mainini and Moretto (2018) is an example of a study where Gordon's Growth model is used as the basis to use a more modified version, in this case it being the stochastic dividend discount model, which is meant to extend the ways results can be achieved in corporate finance. Farrel (1985) and Halicki and Kwater (2018) also explore the possible modifications of the model. Halicki and Kwater (2018) define two reasons why modifications would be needed to do; first being the sensitivity to changes in parameters and second being how the model excludes parameters from the model that can affect the results. A study discussing the advantages of the model also highlighted some of its weaknesses. One of them being the common critique about its functionality with companies not paying dividends. The authors of the study elaborated the topic by adding that forecasting the dividend growth for a longer period than five years is rather challenging, as is also considering thoughtfully planned changes in the dividend growth (Belomyttseva and Grinkevich 2016).

The debate between the weaknesses and strengths can be concluded by saying, that the model's greatest strength is also the one limiting it the most. While the quantitative method allows a number-driven and reliable approach, it completely leaves the qualitative factors out, thus limiting its use and reliability (Mwangi, 2017). Moreover, the models use of dividends has been the centrepiece of many studies talking about its usability, as it has been the reason for studies declaring its faults. To conclude the previous research done on the topic, a notable part of the model is being able to recognize a suitable set of circumstances before applying the model or modifying it.

3.2 Price predictions using Gordon's Growth model

Resende (2020) tested Gordon's Growth model in the US stock market and deemed it not useful as it can possibly lead investors to faulty decisions on where to invest due to the lack of accuracy in predictions. In addition to this, there is also for example one conducted in the Ghana Stock exchange. In this study Gordon's Growth model was used to predict prices for banks, as well as the actual prices were used. The authors also used T-test to test the mean differences during the research time, which was set to 5 years. One of the main observations this study made, was that Gordon's Growth model did not perform statistically significantly in terms of successfully predicting future share prices, it both overvalued and undervalued the predicted stock prices compared to the actual price series. (Acheampong and Agalega, 2013)

The study done by Acheampong and Agalega (2013) was published exactly 10 years ago, and it uses rather similar techniques as this thesis, all though it is examining a larger area, it could be said that there is a limited number of comparable sources from different areas and from different periods of time. By receiving praise and critique, new information and modified methods have formed from Gordon's Growth model. Moreover, there seems to be no stop in sight, thus, leading to this study. If there is new findings, adaptations, and opinions of the model, there is a need for new research, moreover, it means there still is new knowledge to be found. This is proved in a study mentioned before where the author says that there was no previous empirical evidence of the Gordon's Growth model in the US stock market (Resende, 2020). The same continues in the study conducted in Lithuania, which states that the number of studies using the Gordon's Growth model as they did is exceptionally limited (Burinskas and Burinskiene, 2020). Halicki and Kwater (2018) continue this in their study claiming Gordon's Growth model to be attractive research subject due to the possible modifications, which make the model useful for modern economists and makes it no longer irrelevant for financial analysts; part of the reason for new modifications being the highly sensitive assumptions of Gordon's Growth model, thus also creating a need for modifications (Halicki and Kwater, 2018; Ferguson, 1998).

3.3 Conclusion of the literature review

In the basis of the literature review, the first research question "*How accurate is Gordon's Growth in predicting future stock prices in Nasdaq Helsinki"* could be answered followingly: it depends on the situation. In stable industries the usefulness has been proven, but often the assumption of a constant dividend growth does not happen, thus, making the model unreliable. The current situation seems to deem the model not useful nor accurate (Acheampong and Agalega, 2013; Resende, 2020) more times that it is deemed useful. However, it is to be noted that the possibility to modify the model can be seen both as a strength and as a weakness. Can the model truly be useful if it needs modifications? But can it be deemed not useful if it provides a basis for modifications? These are questions that the previous research seems to have conflict over. Furthermore, as the amount of research can be argued not to be thorough enough, this is not enough to make final claims of the usefulness of the model. Furthermore, as none of the previous research are identical to this thesis, the need for further research is certain as the studies cannot be perfectly compared.

4 Data and research method

In this section of the thesis the collected and chosen data will be presented, discussed, and the chosen tool for to conduct the research will as well be presented. This thesis uses a quantitative tool known as the T-test to conduct the comparisons between a time series data: actual and predicted stock prices. Followingly T-tests are also used to examine a cross sectional data on a yearly basis for companies paying regular and irregular dividends. This chapter will follow a certain order which first starts by introducing the chosen companies as well as the date collected from them. In addition, the used variables (dividends, cost of equity, and growth rate) will be presented: first two being found from secondary sources such as company or investing websites and the last one which is calculated. Following this the prediction of the stock prices will be conducted by using the valuation model, Gordon's Growth model. After the comparison between the actual and predicted stock prices will be demonstrated with the T-tests, the comparison between regular and irregular dividend payers is made on a yearly basis, and the T-test explained.

4.1 Data from the chosen companies

This thesis compares ten companies in total from Nasdaq Helsinki, five being regular and five irregular dividend payers. It is to be noted that for regular dividend payers the source for dividends was the company's own website whereas for irregular ones the website investing.com was used to due to the limited information on some of the websites of the companies. For further research, companies not clearly sharing the dividends could be contacted to receive the information from them. Cost of equity was collected from a secondary source which had the information for all the chosen companies, meaning that the way of calculating is expected to be the same. Cost of equity was collected from GuruFocus.com. Finally, the actual stock prices for each year which is to be compared with the prediction of the Gordon's Growth model, is taken from Yahoo Finance. As the Gordon's Growth model uses annualized variables, the actual stock price is calculated by taking the stock price of each month during a year, thus giving an average of the actual stock price for each year. This is the repeated separately for each of the ten chosen companies. To gather the data from Yahoo Finance the time frame was set from January first 2010 to December 31st of 2022 and the search engine defined to show the historical prices monthly.

The data for this thesis was collected at the end of October 2023 and the beginning of November 2023. The timeframe of the study is the reason why the year 2023 was not included in the analysis and the year 2022 was chosen as the last one, as the year 2023 is still in progress and would not be comparable to the others.

4.1.1 Regular dividend payers

As mentioned before, all the companies are active and taken from Nasdaq Helsinki. First the chosen companies which are regular dividend payers are presented. The common thing between these companies is that the dividends have continued to grow since the beginning of the time frame, meaning the dividend payments could be argued to continue – a crucial part of Gordon's Growth model. The five chosen companies are Neste Oyj, Sampo Oyj, Elisa Oyj, Kone Oyj and UPM-Kymmene Oyj have all shared their dividend history on their website, soon presented in table one (Neste, 2023; Sampo, 2023; Elisa, 2023; KONE, 2023;

UPM, 2023). The companies were chosen keeping the assumption of constant dividend growth in mind.

Table 1. Dividends for each company paying them regularly.

Year	NESTE OYJ	SAMPO OYJ	ELISA OYJ	KONE OYJ	UPM-KYMMENE OYJ
2010	0,120	1,150	1,300	0,448	0,550
2011	0,120	1,200	1,300	0,698	0,600
2012	0,130	1,350	1,300	0,873	0,600
2013	0,220	1,650	1,300	0,998	0,600
2014	0,220	1,950	1,320	1,198	0,700
2015	0,330	2,150	1,400	1,398	0,750
2016	0,430	2,300	1,500	1,548	0,950
2017	0,570	2,600	1,650	1,648	1,150
2018	0,760	2,850	1,750	1,648	1,300
2019	1,020	1,500	1,850	1,698	1,300
2020	0,800	1,700	1,950	1,748	1,300
2021	0,820	4,100	2,050	1,748	1,300
2022	1,520	2,600	2,150	1,748	1,500

4.1.2 Irregular dividend payers

Following the regular dividend payers, the irregular dividend payers are presented, which are all as well chosen among the variety of companies from Nasdaq Helsinki. Common thing between the chosen companies is, that there is no clear growth to be noticed or that the number of dividends has decreased since the start of the analysed period. In addition, every single chosen company has not paid dividends for one or more years. The chosen companies are Finnair Oyj, Nokia Oyj, Biohit Oyj, Nurminen Logistics Oyj, and Tulikivi Oyj. Taking the Gordon's Growth model into consideration, these companies can be argued to be unsuitable and unfavourable to use Gordon's Growth model on. However, as the nature of this thesis is to test whether the theory stands correct or has experienced changes, the dividends needed in Gordon's Growth model have also been collected and can be seen on table 2. On the table it can be seen that Finnair has not paid dividends regularly and that there is not as much data to estimate a growth rate like for the regularly paying companies. This is what led to the selection Finnair to be one of the irregularly paying companies. With three out of the four remaining companies, Nokia, Biohit, and Nurminen Logistics all have experienced a decrease in the amount of the dividend, thus leading for the selection. With the final company, Tulikivi, there is no difference to be seen with the amount of the dividend during years 2010-2011 when they paid dividends. (Finnair, 2023; Nokia, 2023; Investing.com, 2023a; Investing.com, 2023b; Investing.com 2023c)

Table 2. Dividends for each company paying them irregularly.

Year	FINNAIR OYJ	NOKIA OYJ	BIOHIT OYJ	NURMINEN LOGISTICS OYJ	TULIKIVI OYJ
2010	0,000	0,400	0,000	0,000	0,025
2011	0,000	0,400	0,000	0,000	0,025
2012	0,100	0,200	1,001	0,070	0,000
2013	0,000	0,000	0,737	0,080	0,000
2014	0,000	0,370	0,723	0,000	0,000
2015	0,000	0,140	0,000	0,000	0,000
2016	0,100	0,260	0,000	0,000	0,000
2017	0,300	0,170	0,000	0,000	0,000
2018	0,274	0,190	0,000	0,000	0,000
2019	0,000	0,100	0,000	0,000	0,000
2020	0,000	0,000	0,000	0,000	0,000
2021	0,000	0,000	0,000	0,000	0,000
2022	0,000	0,060	0,000	0,016	0,000

4.2 Using Gordon’s Growth model to predict stock prices

The companies having been selected and the dividend as well as the cost of equity having been collected, it is possible to apply Gordon’s Growth model. However, before this the variable g, growth rate of the dividend, is calculated by using the past data of the dividends. This links to weak form from efficient market hypothesis, which assesses how well past returns predict future returns (Hatta and Dwiyanto, 2012). The calculation is done with the following equation:

$$g = \sqrt[n]{\frac{Latest\ dividend}{Earliest\ dividend}} - 1$$

Where n is the time frame of the collected data. Furthermore, it is to be noted that in Gordon's Growth model cost of equity cannot be below the growth rate nor the same. In cases where the growth rate exceeded the cost of equity, the growth rate was estimated again by taking the cost of equity and subtracting 2% from its value. For irregular dividend payers the growth rate in some cases was negative if the company experienced a decrease in the amount of the dividends. For the sake of this thesis, the decrease in growth rate is depicted as a negative number to still be able to apply Gordon's Growth model. Even if the decrease is lower than the cost of equity by being a negative number, a decrease of 2% is still taken from the cost of equity in cases where it is needed. This was for example done with Nokia and can be seen on table 3. There we can see that first the estimated growth rate is -14,6% and that the cost of equity is 10,81%. To have a similar approach to the growth rate estimation the formula is as follows: $= -(Cost\ of\ equity - 2\%)$.

Table 3. Example of estimating growth rate again in case of a decrease.

NOKIA OYJ

Ke:	10,81 %
g:	-0,146
adjusted growth rate:	-0,0881

After calculating the growth rates for each company and having the cost of equity, all the necessary variables for Gordon's Growth model are available. It is to be noted, that for companies where either the latest or the earliest dividend (or both) is 0,00, the value zero has been replaced by the latest and earliest non-zero dividend. Gordon's Growth model was then applied for all ten companies and predictions were made. After the predicted stock prices are acquired from using the Gordon's Growth, T-tests are conducted individually for each company to examine whether the difference between actual and predicted stock prices is statistically significant. Finally, the percentual difference between actual and predicted stock prices is taken from each company for each year, and the differences between regular and irregular dividend payers is tested for years 2010-2022.

4.3 T-test assuming unequal variances

T-test is the chosen quantitative method used in this thesis to both compare actual and predicted stock prices inside each company as well as to compare the two groups in a yearly basis: regular and irregular dividend payers. More specifically, the used T-test is the independent samples T-test also known as the two sample T-test with unequal variances (Ross and Willson, 2017). The significance level used in this study is 0,05 (5%) and whether the results are significantly relevant can be seen from the two-tailed p-value. Ross and Willson (2017) continue by stating that if the p-value is below the chosen significance level the null hypothesis can be rejected and there is a statistically relevant difference. Consequently, if the p-value is greater than the significance level the null hypothesis cannot be rejected, and the results are not statistically relevant. This can be portrayed as:

$$H0: no\ significant\ relevance$$

$$H1: a\ significant\ relevance$$

According to Ross and Willson (2017) the test is used to compare the means of the two group which are the same in sample size and in this situation the formula is as follows:

$$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}}$$

$\overline{X_1} = the\ mean\ of\ group\ 1$

$X_2 = the\ mean\ of\ the\ group\ 2$

$s_1^2\ and\ s_2^2 = standard\ deviation$

$n_1\ and\ n_2 = sample\ size\ of\ groups$

T-test was chosen to be the quantitative method for this thesis as its qualities suit well the nature of this study, as the aim of an independent samples T-test is to compare two separate groups, where the sample size is still the same. This is the reasoning behind choosing this specific T-test to use for the testing. The groups in this thesis are actual and predicted stock prices as well as regular and irregular dividend payers.

5 Results

The aim of this chapter is to present the comparison between the predicted stock prices estimated with Gordon's Growth model and the actual stock prices based on historical data. This is done separately for regular and irregular dividend payers and the results are thoroughly analysed. By doing this the comparison will help to answer the sub-question two: "*Is there a statistically significant difference between stock price predictions provided by Gordon's Growth model and the actual stock prices*". Then the analysis is continued to compare regular and irregular dividend payers, to answer the previously mentioned sub-question three: "*What is the difference between regular dividend payers and irregular dividend payers when applying Gordon's Growth model to them*". Both sub-questions help to support the main research question one: "*How accurate is Gordon's Growth in predicting future stock prices in Nasdaq Helsinki*". As stated before, the analysed time frame is 2010-2022.

5.1 Predicted versus actual: Regular dividend payers

The analysis will start with the control group, the companies which have paid dividends regularly. The control group is analysed first due to the common critique toward Gordon's Growth model not being very reliable when applied to irregular dividend payers, as irregular dividend payers can be argued not necessarily always to be able to fulfil the required assumption of constant growth rate for an extended period (Agosto, Mainini and Moretto, 2018; Mishkin, 2016, 188-189). Gordon's Growth model could arguably be expected to provide results for regular dividend payers where there is no statistically significant difference between predicted and actual stock prices, and this is the case for four out of five companies. Kone Oyj is the only regular dividend payer where according to the T-test shown in table 4, there is a statistically significant difference when using the chosen 5% significance level. As the p-value is not greater than the significance level, the null hypothesis can be rejected. With Kone Oyj there is a statistically significant difference between the actual and the predicted stock prices.

Table 4. T-test results for Kone Oyj.

KONE OYJ		
	Predicted	*Actual stock price*
Mean	70,90119519	39,8130127
P(T<=t) two-tail	0,00072428	

For the rest of the companies paying regular dividends, the conducted T-tests do not show a statistically significant difference between predicted and actual stock prices. The null hypothesis of there being no statistically significant difference cannot be rejected with Neste Oyj, Sampo Oyj, Elisa Oyj, and UPM-Kymmene Oyj. However, it is to be noted that even in these cases Gordon's Growth model is still consistently over valuing the stock in its predictions. As an example, the predicted price for Elisa Oyj is overvalued by 190% during 2010-2022 but simultaneously the predicted stock price can be seen mirroring the movements of the actual stock price like seen on figure 2.

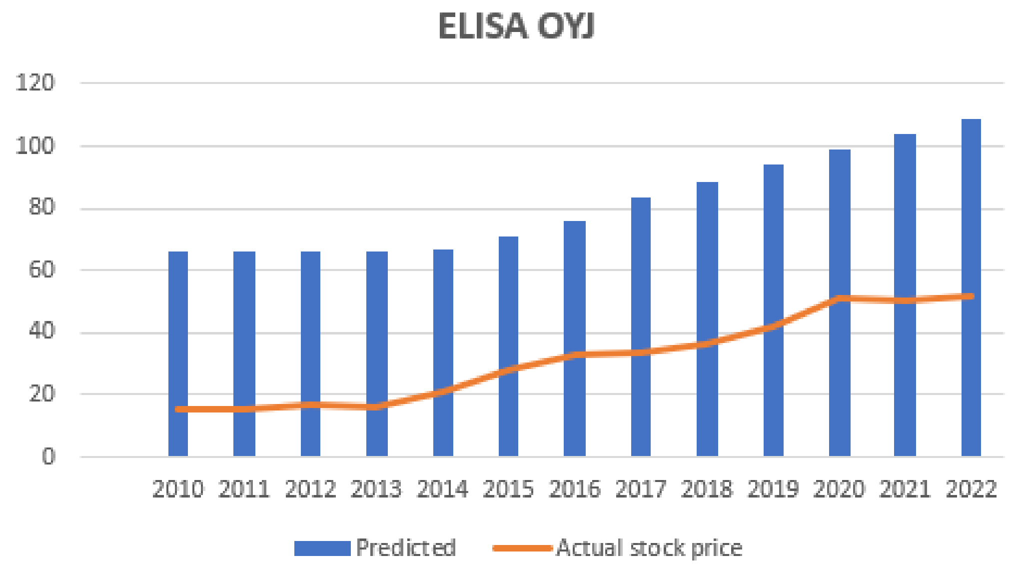

Figure 2. Predicted versus actual stock price for Elisa Oyj.

For Sampo Oyj the average overvaluing percent during 2010-2022 is ~188% and for Neste Oyj the average overvaluing percent during 2010-2022 is ~91%. However, the way the predicted stock price for Neste Oyj conforms the movement of the actual stock price is rather sufficient as can be seen on figure 3. Despite this, the amount of overvaluing is not consistent with the companies. The difference between predicted stock prices and the actual stock prices is marked to be rather large for individual companies as well as if the companies are compared to each other. Furthermore, the amount of overvaluing the stock does not seem to be consistent between regular dividend payers and can be due to many different things: sensitivity of the model, estimated growth rate, age of the company, if the company is trying to signal something with the dividend etc.

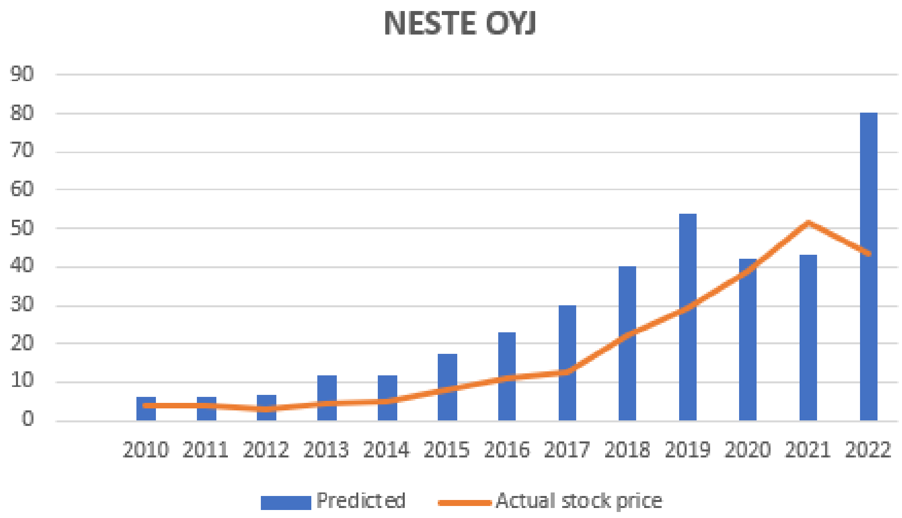

Figure 3. Predicted versus actual stock price for Neste Oyj.

One clear example where there could be something else affecting the overvaluing of the stock price is UPM-Kymmene Oyj where Gordon’s Growth model overvalues the stock by the average of ~961% during the years 2010-2022 like seen on figure 4. One possibly affecting factor is the growth rate, which was the highest out of regular dividend payers for this company. The reason why the growth rate was not adjusted is that it was still under the cost of equity. A nine percent growth rate for a company which barely has experienced growth in the actual stock price, despite the dividend payments getting larger, is making UPM-Kymmene Oyj to be a clear outlier in the results. However, it is to be noted that Gordon's Growth model doesn't take all things affecting the stock market into account, like why the stock of UPM-Kymmene Oyj has grown relatively little during years 2010-2022. Like Mwangi (2017) stated, excluding of the qualitative factors limits Gordon’s Growth models reliability. Furthermore, As B. Mark Smith (2004) and Şenol and Zeren (2020) stated, globalization and new information are also variables affecting the stock market and the stock prices. Thus, the reasoning causing overvalued stock price predictions could be argued to be somewhere else than in the model. However, if the model lacks variables that affect the stock prices significantly, that makes the model not useful when predicting future stock prices. These results also demonstrate the need for a more accurate, or less sensitive, stock valuation model and align with the previous research, like Farrel (1985) and Halicki and Kwater (2018), who have either felt the need for modifications of the model or recognized the possibility for further modifications.

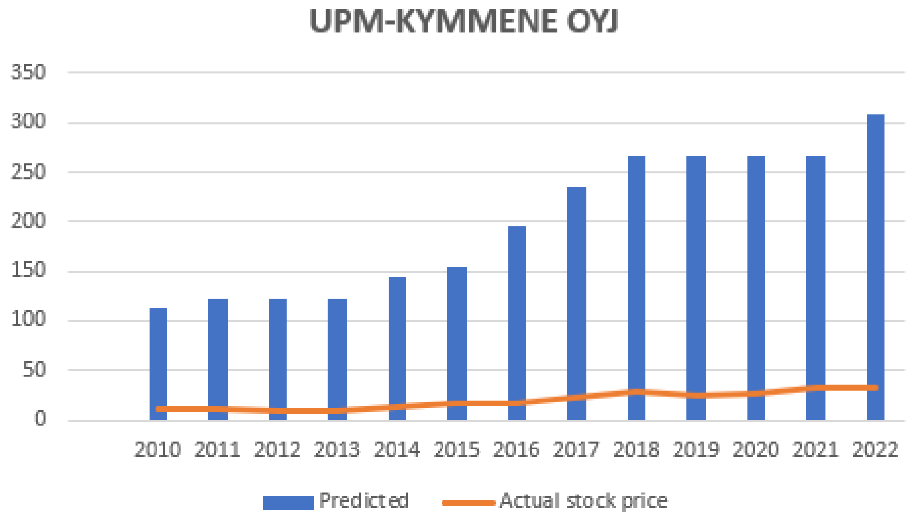

Figure 4. Predicted versus actual stock price for UPM-Kymmene Oyj.

After all his and based on the analysis of the regular dividend payers, the prediction provided by Gordon's Growth model can be said to be sufficient in four out of five cases, as the predictions differed statistically relevantly only with one company, Kone Oyj. This helps to answer sub-question two about the difference between stock price predictions provided by Gordon's Growth model and the actual stock prices. Whilst there is no statistically significant difference with four of the companies, it's undeniable that the predictions are greater than the actual stock price. However, growth rate can reasonably be argued to affect how much the stock price keeps growing in the predictions. Therefore, a suggestion would be to test different ways of estimating the growth rate and see whether it makes a significant difference. To conclude the difference between the predicted stock price and the actual stock price, although being overvalued the results show now significant difference in four out of five cases. Following this, the same process is repeated for irregular dividend payers and the results from this section will also be considered when answering sub-question two on the next chapter.

5.2 Predicted versus actual: Irregular dividend payers

The analysis continues with the group, which according to previous research, should not perform as well as the control group (Agosto, Mainini and Moretto, 2018; Mishkin, 2016, 188-189). In the control group four out of five companies did not experience a statistically significant difference in the results. While Gordon's Growth model consistently overvalued the stock prices for regular dividend payers, that is not the case for irregular dividend payers. One factor in this is that Gordon's Growth model cannot predict a stock price for years where the dividend has been zero. This consequently leads to fewer predictions for all five of the irregular dividend payers. In comparison to other irregular dividend payers, Nokia Oyj has paid dividends on more years than the others. Nokia Oyj has decided not to pay dividends only on years 2013, 2020, and 2021, thus, it is the closest irregular dividend payer to the regular dividend payers in terms of similarity. However, with Nokia Oyj the trend of overvaluing the stock cannot be seen like shown on figure 5. In fact, Gordon's Growth model is seen to be constantly undervaluing the stock price. Nonetheless, when conducting a T-tests Nokia Oyj receives a p-value greater than 5% meaning that there is no statistically significant difference. Nurminen Logistics Oyj is the only other company paying irregular dividends where the p-value was greater than the chosen significance level.

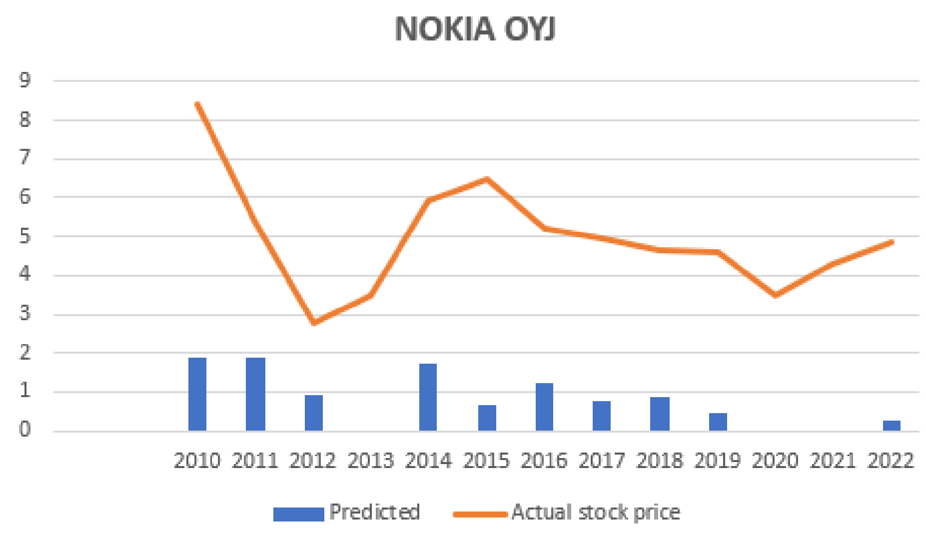

Figure 5. Predicted versus actual stock price for Nokia Oyj.

Tulikivi Oyj, Biohit Oyj, and Finnair Oyj all demonstrated a statistically significant difference between the predicted stock price and the actual stock price as can be seen on table 5. This means that Gordon's Growth model did not perform adequately with these three companies, thus causing there to be a difference between predicted and actual stock prices.

Table 5. T-test results for Tulikivi Oyj, Biohit Oyj, and Finnair Oyj.

TULIKIVI OYJ		
	Predicted	*Actual stock price*
Mean	0,061538462	0,433721154
P(T<=t) two-tail	0,003638721	
BIOHIT OYJ		
	Predicted	*Actual stock price*
Mean	1,317116299	3,844583333
P(T<=t) two-tail	0,00758279	
FINNAIR OYJ		
	Predicted	*Actual stock price*
Mean	1,314168016	3,833560468
P(T<=t) two-tail	0,018191005	

As an example, for Finnair Oyj Gordon's Growth model did not manage to predict the rise on stock price that started around 2014 like seen on figure 6. One of the affecting reasons is that no dividends were paid between 2013-2015. At 2017 Gordon's Growth model predicted a rise in the stock price and 2018 a slight decrease. However, Gordon's Growth model can be deemed not too useful in predicting the future stock prices for irregular dividend payers, as the lack of data leaves much open. The lack of data is also seen with Tulikivi Oyj as it paid dividends only during years 2010-2011 and Biohit Oyj which paid dividends only during 2012-2014. Even though lack of data can be one reason causing there be a significant difference between predicted and actual stock prices, it certainly cannot be the only one due to Nurminen Logistics Oyj not having a statistically significant difference despite only paying dividends 2012-2013 and 2022.

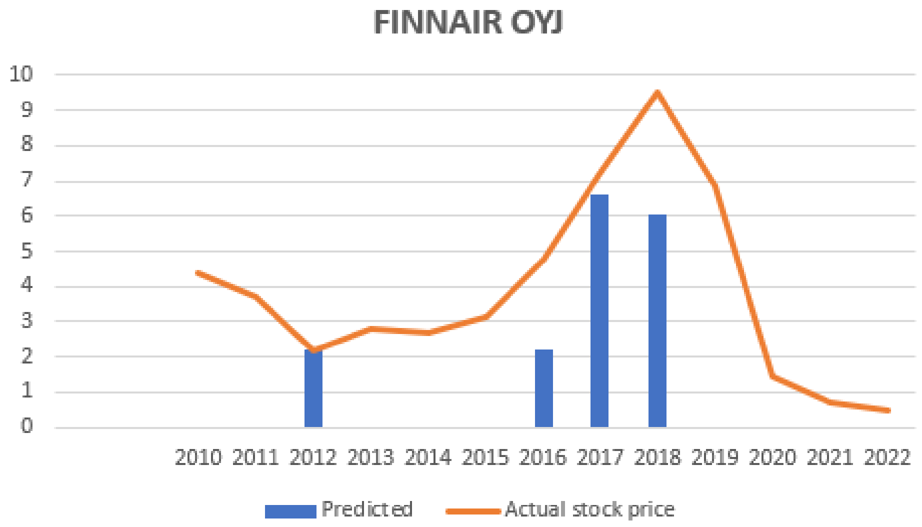

Figure 6. Predicted versus actual stock price for Finnair Oyj.

As three out of five companies experienced a statistically significant difference in the accuracy of the stock price prediction, Gordon's Growth model can be deemed not to be very accurate in irregular dividend payers. This aligns with the previous research. In addition, the excluding of qualitive factors affecting reliability (Mwangi, 2017) can also be applied to irregular dividend payers. To answer sub-question two "*Is there a statistically significant difference between stock price predictions provided by Gordon's Growth model and the actual stock prices?*" it can be said that for irregular dividend payers the difference is statistically significant in three out of five cases. All in all, the difference between the predicted stock price and the actual can be said to be more significant with companies paying irregular dividends. However, as this thesis takes only 10 companies and the results are not evident, this cannot be applied to all regular and irregular dividend payers. This action would require modifications on the model and larger testing groups.

Following this, sub-question three: *"What is the difference between regular dividend payers and irregular dividend payers when applying Gordon's Growth model to them"* is analysed. Based on previous analysis, it seems that the difference is that Gordon's Growth model is more useful with regular dividend payers. However, the comparison of the reliability between the predicted and actual stock prices for regular and irregular dividend payers cannot be accurately by just looking at the p-values, thus, another T-test is made to examine the difference between regular and irregular dividend payers.

5.3 Regular dividend payers versus irregular dividend payers

In this part of the thesis the difference between regular and irregular dividend payers is examined on a yearly basis. This is done by taking the percentual difference of predicted and actual stock prices for each company for each year. In the first set of T-tests all the companies and all the years were included, which lead to there being no statistically significant differences between regular and irregular dividend payers. Partially this can be caused by including the years from irregular dividend payers where there were no dividends paid, thus, Gordon's Growth model could not make suitable predictions for these years. The p-values for each year can be seen on table 6. Sub-question three investigates what the difference between regular and irregular dividend payers is. In the basis of these T-tests there does not seem to be a statistically significant difference as all the p-values are greater than 5%. This answers sub-question three *"What is the difference between regular dividend payers and irregular dividend payers when applying Gordon's Growth model to them*" by demonstrating that there is no statistically significant difference on a yearly basis for regular and irregular dividend payers. Nonetheless, this is an interesting finding as irregular dividend payers were not as accurate with the predictions provided by Gordon's Growth model, as there was a statistically significant difference with three out of five companies.

Table 6. T-test results for comparing regular and irregular dividend payers.

Year	**P-value**
2010	0,075
2011	0,066
2012	0,187
2013	0,142
2014	0,089
2015	0,064
2016	0,090
2017	0,072
2018	0,061
2019	0,100

2020	0,115
2021	0,066
2022	0,080

As Nurminen Logistics Oyj and Nokia Oyj were the only irregular payers where there was not a statistically significant difference between the predicted and the actual stock price, the matter could be investigated further. As Nokia Oyj has paid more dividend than Nurminen Oyj, a comparison can be done with Nokia Oyj and a regular dividend payer, which received a similar P-value when testing for a difference between predicted and actual stock prices. For this comparison Sampo Oyj was chosen as it has a similar p-value. This T-test is takes the percentual difference of predicted and actual stock price individually for each company from 2010-2022 and compares them. The significance level and null hypothesis remain the same as before. In the basis of previous literature, almost surprisingly there does not appear to be a statistically significant difference between Nokia Oyj and Sampo Oyj, as can be seen from table 7.

Table 7. T-test between Nokia Oyj and Sampo Oyj.

	Sampo Oyj	*Nokia Oyj*
Mean	1,882193297	-0,843723228
P(T<=t) two-tail	4,53963E-09	

In the basis of the literature review and comparing the predicted stock prices to the actual ones, a difference between regular and irregular dividend payers was expected. Despite with four out of five regular dividend payers and two out of five irregular dividend payers the null hypothesis could not be rejected, there doesn't appear to be a significant difference on a yearly basis between regular and irregular dividend payers.

6 Conclusions

The aim of this thesis was to test Gordon's Growth models usability and accuracy in companies operating in Nasdaq Helsinki. The companies were divided in to two groups:

regular dividend payers and irregular dividend payers. The thesis examined the difference between predicted and actual stock prices first separately for regular and irregular dividend payers and then finally comparing the accuracy between regular and irregular dividend payers on a yearly basis. In addition to testing the model, the usability of Gordon's Growth model was also discussed in the literature review. Next the sub-questions two and three are answered and following them the conclusion to the main research question is given. Answering the research questions starts with sub-question two:

2. Is there a statistically significant difference between stock price predictions provided by Gordon's Growth model and the actual stock prices?

For regular dividend payers, in four out of five cases there was no statistically significant difference between the predictions calculated with the Gordon's Growth model and with the actual stock prices. However, this does not mean the results to be identical, as well noted in the over-valuing of the stock price. For irregular dividend payers Gordon's Growth model was noted to also undervalued the stock prices. Over-valuing and under-valuing of the stock prices is a consistent result with previous research conducted in the Ghana Stock exchange, which also discovered that there are differences between actual prices and the predictions Gordon's Growth model provided; these differences were both under and overvaluing the stock prices (Acheampong and Agalega, 2013). For irregular dividend payers there was a statistically significant difference between the predicted and actual stock prices in three out of five cases. To conclude the answer to sub-question two, neither group was immune to statistically significant difference, but regular dividend payers performed better. This leads to sub-question three:

3. What is the difference between regular dividend payers and irregular dividend payers when applying Gordon's Growth model to them?

As stated, when answering research question two, irregular dividend payers were more inclined to experience a statistically significant difference between the predicted and actual stock price. Nevertheless, when examining the yearly difference in accuracy between regular and irregular dividend payers a surprising finding was done, there was no statistically significant difference. This was then examined further and according to the results, there still was no statistically significant difference between regular and irregular dividend payers. However, as the comparison was done by taking the percentage difference and it included years when Gordon's Growth model was not able to provide a prediction, it could affect the results. This matter would be worth investigating more, as when answering sub-question two it was noted that irregular dividend payers were more inclined to experience a statistically significant difference compared to the regular dividend payers. As the years where the model could not provide predictions were included, when answering the main research question the answers to sub-question two are held higher in value due to better expectations in accuracy. Based on these results, the main research question can be answered:

1. *How accurate is Gordon's Growth model in predicting future stock prices in Nasdaq Helsinki?*

Gordon's Growth model presents qualities with regular dividend payers where it could it be more useful and accurate than with irregular dividend payers. This aligns with previous literature which criticize its ability to function if the company is paying irregular dividends (Agosto, Mainini and Moretto, 2018; (Belomyttseva and Grinkevich, 2016). Thus, it can be said that Gordon's Growth model is more useful and accurate in companies paying regular dividends. Even though the predictions calculated with the model did not showcase a statistically significant difference in more than one cases with regular dividend payers, it still unarguably over-valued the stock prices. It is due to this, that this study deems the model not useful alone. However, it neither denies that it could be useful as a basis for a more complex model which could take into consideration qualitative factors which Mwangi (2017) discusses while critiquing how Gordon's Growth model does not take them into consideration.

For future research, the accuracy of the modified models could be examined. Future research could also take a larger sample size than the used ten companies, as the results showcase a potential to take a closer look in to the accuracy of the predictions and the differences between regular and irregular dividend payers. To be more specific, regular, and irregular dividend payers could be further divided into groups by industry, age, size, and other possible factors. By growing the sample size to a greater number this would be possible.

Finally, different ways of estimating the growth rate could be tested to analyse whether one works better than the other, as it can affect the results.

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APPENDICES

Appendix 1. Cost of equity and growth rates.

NESTE OYJ

Ke:	7,81 %
g:	0,2356
adjusted growth rate:	0,058

SAMPO OYJ

Ke:	9,25 %
g:	0,070

ELISA OYJ

Ke:	3,49 %
g:	0,043
adjusted growth rates:	0,015

KONE OYJ

Ke:	7,99 %
g:	0,120
adjusted growth rate:	0,060

UPM-KYMMENE OYJ

Ke:	9,25 %
g:	0,09

FINNAIR OYJ

Ke:	13,69 %
g:	0,088

NOKIA OYJ

Ke:	10,81 %
g:	-0,146
adjusted growth rate:	-0,088

BIOHIT OYJ

Ke:	11,32 %
g:	-0,027

NURMINEN LOGISTICS OYJ

Ke:	8,17 %
g:	-0,116
adjusted growth rate:	0,062

TULIKIVI OYJ

Ke:	6,25 %
g:	0,000

Appendix 2. Actual stock prices.

Year	NESTE OYJ	SAMPO OYJ	ELISA OYJ	KONE OYJ	UPM-KYMMENE OYJ
2010	3,906	18,252	15,286	16,944	10,385
2011	3,624	20,878	15,649	20,395	11,916
2012	2,998	21,266	16,693	23,854	9,063
2013	4,144	30,141	16,297	31,377	9,238
2014	5,082	36,516	21,072	31,713	12,325
2015	7,806	43,150	28,123	38,423	16,073
2016	10,882	40,094	32,660	42,135	17,730
2017	12,688	43,760	33,646	43,518	23,534
2018	21,982	43,170	36,228	43,961	29,431
2019	29,356	38,531	41,927	49,370	25,617
2020	38,874	33,659	51,217	62,502	26,232
2021	51,413	39,932	50,696	65,648	31,793

2022	43,594	44,228	52,117	47,731	32,297

Year	FINNAIR OYJ	NOKIA OYJ	BIOHIT OYJ	NURMINEN LOGISTICS OYJ	TULIKIVI OYJ
2010	4,393	8,416	2,428	1,852	1,323
2011	3,698	5,436	2,493	1,275	1,001
2012	2,169	2,757	2,686	1,077	0,612
2013	2,809	3,477	6,381	1,077	0,448
2014	2,698	5,914	6,408	0,804	0,283
2015	3,153	6,504	5,292	0,678	0,179
2016	4,790	5,188	5,532	0,473	0,194
2017	7,176	4,935	5,485	0,552	0,222
2018	9,510	4,673	4,153	0,467	0,163
2019	6,861	4,583	2,864	0,308	0,137
2020	1,429	3,483	2,592	0,298	0,135
2021	0,685	4,292	2,113	1,092	0,404
2022	0,467	4,866	1,553	1,052	0,539

Appendix 3. Predictions made with Gordon's Growth model.

Year	NESTE OYJ	SAMPO OYJ	ELISA OYJ	KONE OYJ	UPM-KYMMENE OYJ
2010	6,349	55,553	65,969	23,715	112,891
2011	6,349	57,969	65,969	36,964	123,154
2012	6,878	65,215	65,969	46,238	123,154
2013	11,639	79,707	65,969	52,863	123,154
2014	11,639	94,199	66,983	63,462	143,679
2015	17,459	103,860	71,043	74,061	153,942
2016	22,749	111,106	76,118	82,010	194,993
2017	30,156	125,599	83,729	87,309	236,044
2018	40,208	137,675	88,804	87,309	266,833
2019	53,963	72,461	93,878	89,959	266,833
2020	42,324	82,122	98,953	92,609	266,833
2021	43,382	198,059	104,027	92,609	266,833
2022	80,416	125,599	109,102	92,609	307,884

Year	FINNAIR OYJ	NOKIA OYJ	BIOHIT OYJ	NURMINEN LOGISTICS OYJ	TULIKIVI OYJ
2010	0,000	1,859	0,000	0,000	0,400
2011	0,000	1,859	0,000	0,000	0,400
2012	2,207	0,930	6,963	3,716	0,000
2013	0,000	0,000	5,127	4,247	0,000
2014	0,000	1,720	5,033	0,000	0,000
2015	0,000	0,651	0,000	0,000	0,000
2016	2,207	1,208	0,000	0,000	0,000
2017	6,622	0,790	0,000	0,000	0,000
2018	6,048	0,883	0,000	0,000	0,000
2019	0,000	0,465	0,000	0,000	0,000
2020	0,000	0,000	0,000	0,000	0,000
2021	0,000	0,000	0,000	0,000	0,000
2022	0,000	0,279	0,000	0,849	0,000

Appendix 4. T-tests comparing predicted stock prices to actual stock prices.

NESTE OYJ

	Predicted	*Actual stock price*
Mean	28,73148462	18,18072622
Variance	505,6462768	293,6368322
Observations	13	13
Hypothesized Mean Difference	0	
df	22	
t Stat	1,345566099	
P(T<=t) one-tail	0,096073827	
t Critical one-tail	1,717144374	
P(T<=t) two-tail	0,192147655	
t Critical two-tail	2,073873068	

SAMPO OYJ

	Predicted	*Actual stock price*
Mean	100,7018051	34,89050229
Variance	1579,429551	87,82555927
Observations	13	13
Hypothesized Mean Difference	0	
df	13	
t Stat	5,811271093	
P(T<=t) one-tail	3,03053E-05	
t Critical one-tail	1,770933396	
P(T<=t) two-tail	6,06106E-05	

t Critical two-tail	2,160368656

ELISA OYJ

	Predicted	*Actual stock price*
Mean	81,27006923	31,66230778
Variance	258,2284987	200,3026971
Observations	13	13
Hypothesized Mean Difference	0	
df	24	
t Stat	8,352891924	
P(T<=t) one-tail	7,28821E-09	
t Critical one-tail	1,71088208	
P(T<=t) two-tail	1,45764E-08	
t Critical two-tail	2,063898562	

UPM-KYMMENE OYJ

	Predicted	*Actual stock price*
Mean	198,9402764	19,66416667
Variance	5117,709901	77,78048363
Observations	13	13
Hypothesized Mean Difference	0	
df	12	
t Stat	8,967694872	
P(T<=t) one-tail	5,73402E-07	
t Critical one-tail	1,782287556	
P(T<=t) two-tail	1,1468E-06	
t Critical two-tail	2,17881283	

NOKIA OYJ

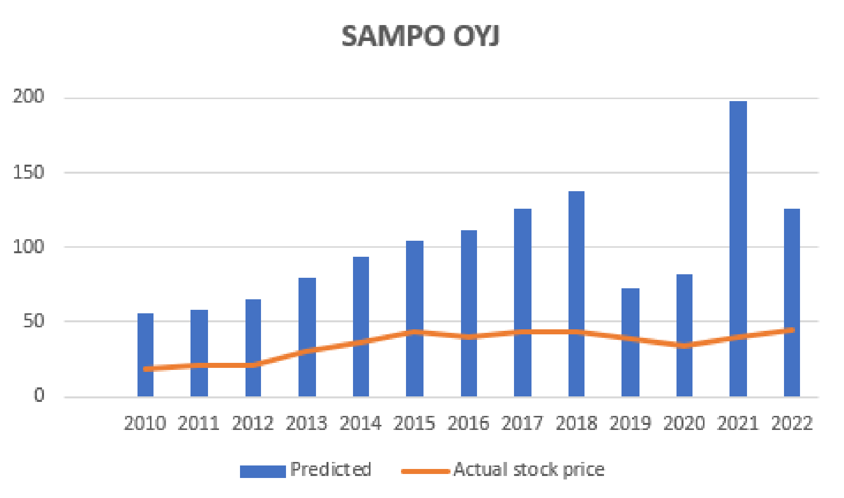
	Predicted	*Actual stock price*
Mean	0,818729319	4,963439103
Variance	0,466799712	2,118877283
Observations	13	13
Hypothesized Mean Difference	0	
df	17	
t Stat	-9,293486378	
P(T<=t) one-tail	2,24089E-08	
t Critical one-tail	1,739606726	

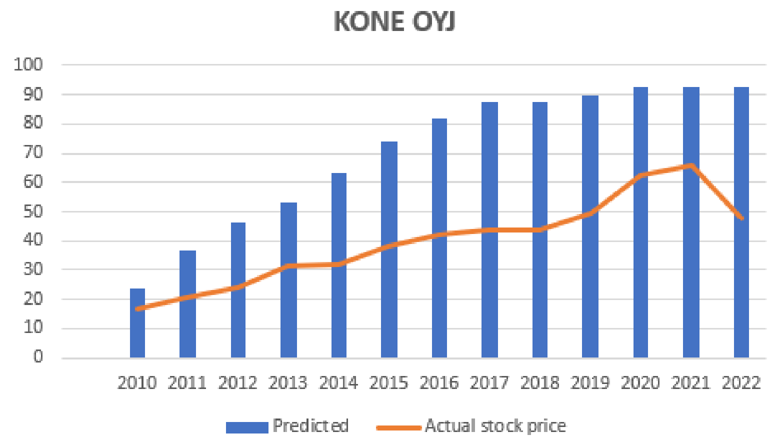
P(T<=t) two-tail	4,48179E-08
t Critical two-tail	2,109815578

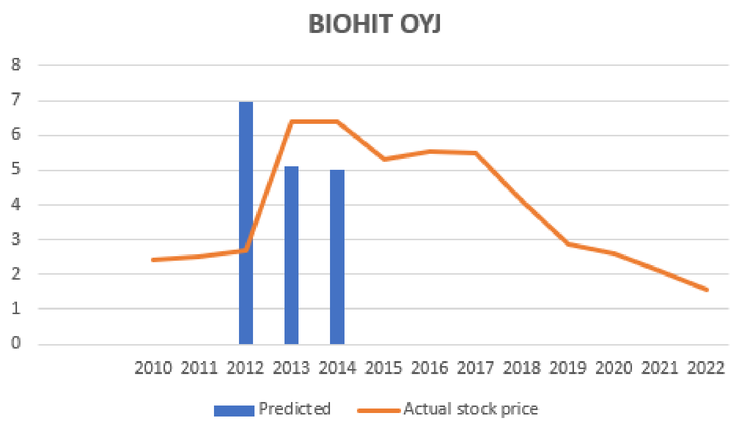
NURMINEN LOGISTICS OYJ

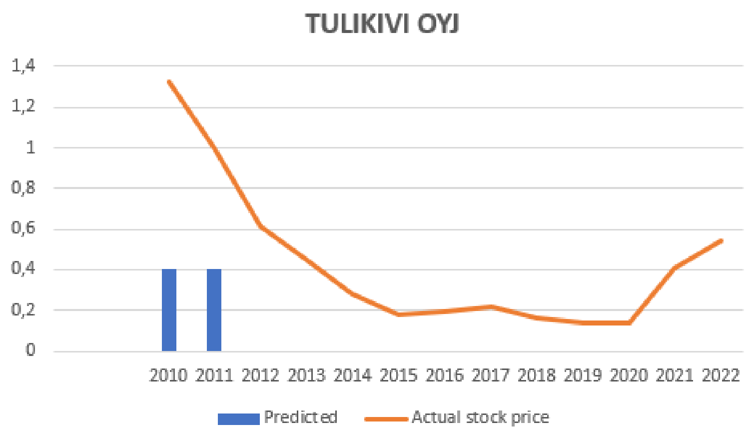
	Predicted	*Actual stock price*
Mean	0,677854615	0,846578128
Variance	2,215973135	0,199692367
Observations	13	13
Hypothesized Mean Difference	0	
df	14	
t Stat	-0,391407269	
P(T<=t) one-tail	0,35069438	
t Critical one-tail	1,761310136	
P(T<=t) two-tail	0,701388761	
t Critical two-tail	2,144786688	

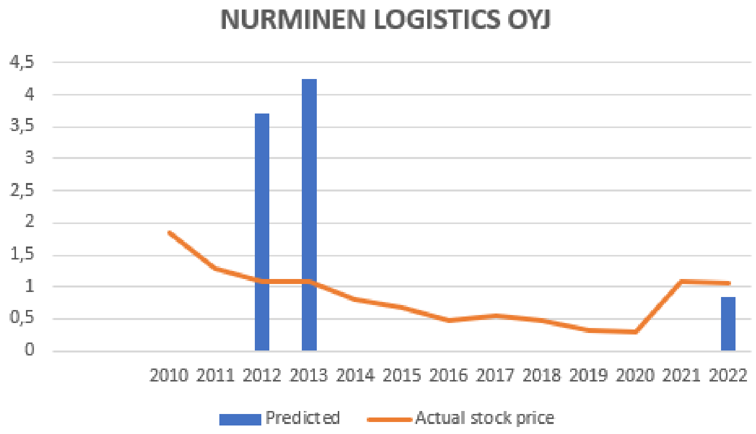
Appendix 5. Predicted stock prices versus actual stock prices.




KONE OYJ
100
90
80
70
60
50
40
30
20
10
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022
Predicted
Actual stock price


BIOHIT OYJ
8
7
6
5
4
3
2
1
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022
Predicted
Actual stock price


TULIKIVI OYJ
1,4
1,2
1
0,8
0,6
0,4
0,2
0
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022
Predicted
Actual stock price



Appendix 6. T-tests comparing regular dividend payers to irregular dividend payers.

	Regular 2010	Irregular 2010	Regular 2011	Irregular 2011	Regular 2012	Irregular 2012	Regular 2013	Irregular 2013
Mean	3,251101038	-0,895326944	3,178333161	-0,851669339	3,967846194	0,479627125	3,90340747	-0,050841921
Variance	15,07735086	0,021374635	12,83983173	0,041669603	23,82044038	2,208216919	22,90294739	2,920806722
Observations	5	5	5	5	5	5	5	5
Hypothesized Mear	0		0		0		0	
df	4		4		5		5	
t Stat	2,386101886		2,510770841		1,528842938		1,739960422	
P(T<=t) one-tail	0,037743399		0,033001528		0,09342408		0,071176116	
t Critical one-tail	2,131846786		2,131846786		2,015048373		2,015048373	
P(T<=t) two-tail	0,075486799		0,066003055		0,186848159		0,142352233	
t Critical two-tail	2,776445105		2,776445105		2,570581836		2,570581836	

	Regular 2014	Irregular 2014	Regular 2015	Irregular 2015	Regular 2016	Irregular 2016	Regular 2017	Irregular 2017
Mean	3,341500024	-0,784759296	2,734918784	-0,979990216	3,027296077	-0,861252538	2,954312689	-0,783418753
Variance	16,91619803	0,117451428	10,71798726	0,002001957	15,28197601	0,042586176	11,6299235	0,160659799
Observations	5	5	5	5	5	5	5	5
Hypothesized Mear	0		0		0		0	
df	4		4		4		4	
t Stat	2,235566884		2,537090783		2,221153113		2,434027331	
P(T<=t) one-tail	0,044529424		0,032089484		0,045248075		0,035834349	
t Critical one-tail	2,131846786		2,131846786		2,131846786		2,131846786	
P(T<=t) two-tail	0,089058849		0,064178969		0,09049615		0,071668698	
t Critical two-tail	2,776445105		2,776445105		2,776445105		2,776445105	

	Regular 2018	Irregular 2018	Regular 2019	Irregular 2019	Regular 2020	Irregular 2020	Regular 2021	Irregular 2021
Mean	2,704387219	-0,835014075	2,639215185	-0,979717179	2,422891356	-1	2,531809055	-1
Variance	9,264199136	0,076011098	14,38090789	0,002056964	14,48952643	0	9,895550963	0
Observations	5	5	5	5	5	5	5	5
Hypothesized Mear	0		0		0		0	
df	4		4		4		4	
t Stat	2,58962263		2,133738822		2,010717331		2,510511574	
P(T<=t) one-tail	0,030354028		0,049893746		0,057352534		0,033010658	
t Critical one-tail	2,131846786		2,131846786		2,131846786		2,131846786	
P(T<=t) two-tail	0,060708056		0,099787491		0,114705068		0,066021316	
t Critical two-tail	2,776445105		2,776445105		2,776445105		2,776445105	

	Regular 2022	Irregular 2022
Mean	2,650220548	-0,827102239
Variance	10,96788206	0,126340645
Observations	5	5
Hypothesized Mear	0	
df	4	
t Stat	2,334433833	
P(T<=t) one-tail	0,03993168	
t Critical one-tail	2,131846786	
P(T<=t) two-tail	0,07986336	
t Critical two-tail	2,776445105	