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# Dividend Price Pressure on Oslo Stock Exchange

*Assessing the effect of dividend reinvestments on daily market returns*

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# Abstract

This thesis assesses the existence of dividend price pressure on Oslo Stock Exchange by measuring daily market returns against aggregate dividend payment yields. The thesis studies the period from January 2005 to November 2020.

We find evidence that predictable cash inflows from dividend reinvestments lead to abnormal daily market returns when controlling for oil price and global market variation. The base regression shows that a 0.1% increase in the aggregate daily dividend yield predicts increased daily value weighted market returns of 2.5 basis points. We also find that days in the top 5 of the recent rolling year's largest aggregate dividend payment yields exhibit significantly higher returns with control variables. However, alternative measurements place doubt on these results. Also, we test but cannot conclude whether the substantial state ownership on Oslo Stock Exchange affects obtained results. When excluding control variables, we find no evidence that predictable price pressure exists.

Considering that we find no evidence without control variables, and somewhat unsteady evidence with, it comes as no surprise that the economic significance of the studied effects is highly limited. The magnitudes of the results are miniscule and, for an investor on the Oslo Stock Exchange, next to completely irrelevant.

# Acknowledgments

This thesis has proved to be a worthy end to five years of studies at NHH. We found the process challenging, yet in the end a meaningful endeavour. It has allowed us to delve into new and interesting theories, and as such challenge our ability to construct a meaningful analysis. We have obtained the utmost respect for the work that goes into producing academic literature, and hope our thesis proves an interesting read.

We would like to thank our supervisor, Walter Pohl, for his guidance in writing this thesis. We also extend our gratitude towards family and friends, whose patience with us during this process has been much appreciated. Finally, we would like to thank professors and fellow students for making our time at NHH a memorable experience.

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# 1. Introduction

## 1.1 Background

> "*Economics is about supply and demand – just not in financial markets"* (The Economist, 2021)

Standard financial markets theory derives the value of a company from the sum of its discounted future cash flows[1] (Berk & DeMarzo, 2017). For years this has been the bedrock of asset pricing in financial literature and financial press, and curriculum at every business school (Summers, 1986). Over the last years however, we have seen trades that hardly can be seen as reactions to updates in financial numbers, and that are probably rather disconnected to fundamentals of the companies in question. *Gamestop*, *Tesla* (and twitter-updates) and *AMC* are just some examples of stock runs that have or has at times come from what traditional financial theory would deem irrational investor behaviour. Financial theory relies on the assumption that rational investors realise when deviations occur and engage in trades off-setting this effect (Fama, 1965), yet this is not observed in these examples. As such, it begs the question of the exhaustiveness of the standard theory, whose support is still strong from economists such as Fama (Rusoff, 2021) and Malkiel (2003).

Recently, an Economist article highlighted University of Chicago Booth professors Xavier Gabaix and Ralph S. J. Koijen's work on what they call the *Inelastic Market Hypothesis* (2021) – a hypothesis in contrast with asset pricing theory. Their work show how the inflows of "new" money to the market increases the aggregate market value by more than the initial inflow. This is a clear breach of asset pricing theory and also provides evidence that interpreting financial markets with a supply and demand view has merit.

After the release of their research, an offspring to their discovery resulted in a paper, *Predictable Price Pressure* (Hartzmark & Solomon, 2021). Fellow Chicago Booth professor Samuel M. Hartzmark and Boston College professor David H. Solomon found how payment of dividends represents predictable buying pressure, resulting in higher value-weighted market

[1] Equity value, adjusted for cash and debt.

returns. They conducted their work mainly in the US but also found that the results hold true on an international level (Hartzmark & Solomon, 2021).

Our motivation to conduct our thesis around these two papers stems primarily from an interest in financial markets and to gain a deeper understanding of the anomalies that occur. While Gabaix and Koijen (2021) highlight many ways in which inelasticity can have an effect on markets, Hartzmark and Solomon provide a testable approach to price pressure, a “subset” to the inelasticity, and gives us the opportunity to infer at least some points on the *Inelastic Market Hypothesis*. Most notably, dividends are interesting because it is *predictable*. While we do not claim that one might be able to exploit the predictability, it does provide an interesting topic in which further research can shed light on anomalies that has previously been conceived by some as “unidentified risk factors” (Cassidy, 2013).

Furthermore, we choose to study the Oslo Stock Exchange (Norway) for a multitude of reasons. Both Gabaix and Koijen, and Hartzmark and Solomon focus primarily on American exchanges. The Oslo Stock Exchange is somewhat different to the American markets, and thus provides an opportunity to research whether their findings and interpretations are transferable to markets with a different set of attributes. The main attributes in question are size of the market, Norway’s oil dependency, state ownership and a few large companies accounting for a large fraction of the total market value. Oslo Stock Exchange does not provide the same richness in number of companies, and the oil dependency and government ownership are factors which are rather unique to the Oslo Stock Exchange.

## 1.2 Research Topic

Our research topic relates to the work of Gabaix and Koijen, as well as Hartzmark and Solomon. We conduct research on the back of their work in two ways: 1) We engage in a qualitative assessment of Gabaix and Koijen’s assumptions and if one might expect Dividend Price Pressure on Oslo Stock Exchange, and 2) We perform a quantitative analysis of Oslo Stock Exchange on the back of these assumptions. We use Hartzmark and Solomon’s knowledge of the American exchanges regarding Price Pressure to able to induce the same study on Oslo Stock Exchange.

We aim to adjust for factors that are distinctive for a smaller market such as Oslo Stock Exchange to investigate if dividend reinvestments can cause price pressure on Oslo Stock

Exchange. By running regressions with control variables who takes notice of these unique characters we aim to build on the work of Gabaix and Koijen's work on inelasticity, and Hartzmark and Solomon's work on a specific form of price pressure, namely dividends.

## 1.3 Structure

The thesis consists of six chapters. Chapter two through six covers the theoretical framework, a qualitative analysis, data, quantitative analysis, and conclusion, respectively. In the first part of the theoretical framework, we elaborate on asset pricing theory and the efficient market hypothesis. We discuss the work of Fama and Malkiel, as supporters of the efficient market hypothesis and contrast it with the work of prominent behavioural economics researchers such as Shiller, De Bondt and Thaler. We move on by looking at and interpreting financial markets in a supply and demand model, as it is important for understanding Gabaix and Koijen's reasoning, and how some anomalies might occur. Furthermore, we address the *Inelastic Market Hypothesis* specifically, the assumptions behind and their results. Lastly, we tie together the work of Gabaix and Koijen with that of Hartzmark and Solomon, as well as the supply and demand model, to show how one can test for price pressure, specifically Dividend Price Pressure.

In chapter three we make a qualitative judgement on if we should expect dividend price pressure on Oslo Stock Exchange. Our discussion will revolve around the assumptions of Gabaix and Koijen, as well as specific characteristics of Oslo Stock Exchange. With chapter four we introduce data meant for use in the quantitative analysis of dividend price pressure on Oslo Stock Exchange. Some of these data are tied to our discussion in chapter three. In chapter five we make a quantitative judgement of dividend price pressure on Oslo Stock Exchange. We start out with our base test and extend it by including various control variables. Lastly, in chapter six, we draw conclusions based on our qualitative and quantitative assessment of Oslo Stock Exchange and elaborate on potential pitfalls and extensions to our research.

# 2. Theoretical Framework & Litterature Review

## 2.1 Theory Introduction

To enable a thorough analysis of the market reaction to increased flows and the different types as such, it is necessary to review literature that sheds light on the particular dynamics that both determine and create fluctuations in stock prices and aggregate market values. Thus, our review of literature consists of four parts that we deem critical to understanding the underlying concepts and theories of these determinants.

We find it important to first address the fundamental idea of what a stock and its value is. A stock market allows for trading of individual stocks, thus, understanding the drivers of a single company's value is important. However, deriving the fundamental[2] value of a stock with uncertain future cash flows is difficult. Secondly, we therefore move forward by addressing how markets provide a platform for investors to trade these stocks such that prices might reflect the true fundamental value of the stocks. Theories on the behaviour of the stock markets might suggest how flows such as dividend reinvestments should be consumed by the market and its investors. In classical financial theory, the Efficient Markets Hypothesis entails that investors trade in such a way that the market value is a good approximation of the true value (Berk & DeMarzo, 2017). However, every now and then anomalies occur that are seemingly not correlated with fundamental variables, and thus potentially drive stock prices away from their fundamental value (Woi et al., 2020). This warrants a discussion of whether the EMH is exhaustive in addressing market reactions, or whether there are shortcomings that require the inclusion of alternative hypotheses to understand other probable reactions. Thirdly, we therefore extend the review by discussing a supply and demand approach to interpreting markets. "Standard" supply and demand models in stock markets are not that easily interpreted, thus we utilise an alternative and more intuitive approach of supply and demand. We also carefully start to address Price Pressure in this part before we expand on this in an own section. Fourthly, when the supply and demand interpretation has been understood, we provide assumptions from new research that we believe are well suited in the price pressure

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[2] Fundamental, i.e., the characteristics and factors that helps constitute the underlying core value of the company (TheStreet, 2021)

context. Lastly, we draw attention to price pressure and dividend theory, which lays the foundation for our analysis on dividend price pressure and abnormal returns.

## 2.2 The Fundamental Value of a Stock

A stock is an ownership share of a company. This ownership, among else, gives the stockholder rights to receive his/her fair share of the company's profits. In its simplest form, this reward is given to investors by means of a cash dividend payment, where the total payment is in proportion to the size of the share. However, the company may sometimes want to withhold dividend payments, and instead use the cash to invest in new projects and thus grow the future earnings of the company. The investor might agree and deem this a good idea because then the company can pay dividends in the future that may surpass what it is able to pay out at the current point in time. It is important to note that there is still an expectation that at some point, whenever this may be, the dividends will eventually be paid out.

In this simplified world, the dividends that the company eventually pays, is the only cash an investor will get from owning the company, unless they sell their position (Berk & DeMarzo, 2017). If all information about the future of the company is known, the value of a certain share of the company can easily be found as the sum of all the discounted future payments. For the investor, receiving the future payments obviously entails owning the company share, and thus binding up capital which may have been deployed elsewhere in the given time frame. Hence, the investor requires a certain return equal to the return he might receive from placing capital elsewhere, in projects of similar risk (Berk & DeMarzo, 2017). In other words, the future dividend payments received from the company must be discounted by the required rate of return. Knowing the discount rate, and the future value of the dividend payments, an objective[3] value can be assigned to a share of the company. This is given by the dividend discount model as (Penman, 1998):

$$Stock\ price^{4} = \sum_{i=0}^{n} \frac{DPS_i}{(1+r)^i}$$

[3] Objective in a very simplified world, where all information is known

[4] DPS, Dividend per share

In a world where the discount rate and the exact value of future cash flows is not known, i.e., the real world, the value is obviously no longer objective, but rather subjective, and highly sensitive to each individual investor's expectations. Thus, investors must agree on a price whenever they want to trade.

For some companies, shares are publicly traded, i.e., ownership of the companies can easily be exchanged if there are willing buyers and sellers at the prevailing market price. The market price of a stock represents its fair value, but is an approximation based on the reasonable subjective beliefs of the individual market participants (Fama, 1965). However, when markets are made of subjective participants whose perception of a stock differs, it is certainly worth discussing whether it is reasonable that only fundamentals influence market prices. Even though it has been studied for many decades, definitive conclusions on whether stock prices are efficient at reflecting fundamental values are yet to be reached. Thus, it is necessary with a review of the literature on how stock prices behave when placed in a complex system such as markets.

## 2.3 Efficient Markets Hypothesis (EMH)

To begin studying markets, and how they can provide a reasonable view on the fundamental value of stocks and the aggregate market value, this section will review the leading classical theory within studies of financial markets. This theory and its shortcomings will be highlighted, as it is discussed whether markets can be fully explained by this broadly used theory, or whether other views on how markets work need to be consulted. In broader terms with regard to this thesis, this section helps systemise the interpretation of financial markets and thus set a context for the study of dividend price pressure.

The most studied and widely used interpretation of markets is the Efficient Markets Hypothesis (hereby EMH). The hypothesis is taught in academia, and generally used as a starting point when seeking to understand and study market dynamics (Summers, 1986). The EMH is often used as a reference to which new theories can either relate or breach. The theory was first termed in 1967 by Harry Roberts (1967), but related literature can be found as early as 1863 (Sewell, 2011). From the 1970s and onwards, a new school of thought rose to the debate, arguing that the market efficiency is over-exaggerated (Shiller, 2003). Until this day, there is no definitive conclusion on to which extent the EMH holds.

The general idea of the Efficient Markets Hypothesis is that the markets consist of many profit-maximising and rational traders who actively compete in trying to predict the future value of a company and thus its stock price, based on currently available information (Fama, 1965). The fact that these traders actively, and to the best of their efforts, try to interpret the available information, leads to an equilibrium type state where the stock prices reflect well the underlying fundamental value (Fama, 1965). This definition of efficient markets entails that no one trader can consistently beat the market through fundamental or technical analysis of available information. Both Fama (1965) and Malkiel (2003) argue that this is because whenever a stock price moves above or below the fundamental value, arbitrageurs[5] will realise this and engage in off-setting trades, thus keeping the stock price at or close to its fundamental value.

The general version of EMH is as above, but Fama (1970) expands on three different variations of EMH, where the degree of information contained in the stock prices distinguishes the three forms. These subcategories are the weak form, the semi-strong form and the strong form. Weak form efficient markets consider only historical market data to be reflected in the stock price. Achieving above-normal returns utilising historical price data, i.e., technical analysis[6], is therefore not possible (Malkiel, 2003). The semi-strong form efficient markets also consider stock prices to reflect all other publicly available information, thus implying that fundamental analysis should not yield above-normal returns (Brealey, Myers & Allen, 2017; Malkiel, 2003). Lastly, the strong form efficient markets consider all aspects of the weaker forms but also assumes that private information is reflected in the stock price (Finnerty, 1976). Thus, the strong form hypothesis depicts that insider trading will not yield abnormal returns. When referring to efficient markets in general terms, the strong form is often the point of reference (Cochrane et al., 2017).

Under the strong form of efficient markets, it can be inferred that markets depict the fundamental value of stocks rather well. However, critics of the assumptions on which the various forms of EMH are built are many. On this point there are arguments from various financial researchers that point out weaknesses in the assumptions of EMH, with particular

[5] I.e., someone who tries to exploit market inefficiencies to their gain (Chen, 2019)

[6] “Technical analysis is essentially the search for recurrent and predictable patterns in stock prices.” (Bodie et al., 2014, p. 354)

emphasis on the assumptions of rational investors and immediate correction of deviations from fundamental values.

Robert Shiller (2003) makes compelling arguments based on examples of market anomalies[7] from research in the behavioural finance sphere. He points out that so-called "feedback models" do not adhere to the EMH. He argues that when speculative prices[8] go up, it creates success for some investors, and that when this success is conveyed through news and word-of-mouth, it creates an enthusiasm and added attention to certain trading strategies (Shiller, 2005). This then generates further price movements and enforces the original speculative trading. Furthermore, he argues that this effect can create Bubbles[9] that temporarily drives stock prices to unsustainable heights as, arguably, fundamental values cannot follow the same growth as the stock price exhibits in these cases. Thus, in feedback models, the behavioural biases of investors lead to markets not being efficient, as it implies that markets do not correct themselves as assumed. "Feedback models" are documented in behavioural finance and supported in literature, by among other psychologists Andreassen and Kraus (1988), and Smith, Suchanek and Williams (1988) in the same year.

Other arguments against EMH are made by De Bondt and Thaler (1985, 1987). Also coming from behavioural finance, they argue that the EMH fails to recognise well documented effects of investors not being rational. For instance, the "Winner Loser Effect" shows how investors typically assign greater value to a portfolio whose past performance has been good, whilst being too pessimistic of portfolios whose performance has been weak. They further argue that this leads to stock prices deviating from their fundamental values (De Bondt & Thaler; 1985, 1987). Thus, by the arguments above, expecting the EMH to always hold is probably not reasonable.

Given the arguments above, the strong form of efficient markets seems unlikely to be true, and Fama (1970) himself admits this is probably unrealistic. However, he does believe that the semi-strong and weak form efficiency hypotheses still hold. This is backed by Burton G. Malkiel (2003), who argues that the apparent difficulty of consistently obtaining abnormal

[7] Deviations in stock prices from the EMH (Latif et al., 2011).

[8] Stock prices where there are expectations of extraordinary returns, as a consequence of large risk taking (Matthews II, 2021)

[9] A phenomenon where stock prices rise way above fundamental values (Nasdaq, n.d.).

returns is a strong case for the existence of some form of efficient markets. It can also be argued that the irrational behaviour pointed out by critics is not disproving of the EMH, but rather is incorporated in the EMH. By this it is meant that sometimes market prices in retrospect turn out to be wrong. However, if markets are rational, we can expect prices to average out over the longer term (Bodie et al., 2014, p. 354), thus implying that short term irrational behaviour may occur. In other words, the EMH does not necessarily neglect the existence of anomalies. As Fama views it, these anomalies can rather be seen as “unidentified risk factors” (Cassidy, 2013).

As the vast research on the EMH suggests, there is little unity on exactly how efficient markets are and thus also how well financial markets approximate the true value of a stock. However, almost all literature points out or acknowledges the existence of some forms of anomalies. While Fama simply attributes anomalies to “unidentified risks” (Cassidy, 2013), behaviouralists suggest that these “risks” are more tangible than what Fama implies. Anyhow, as this paper seeks to investigate dividend price pressure, which is a concept that is not directly unified with the EMH, anomalies to the EMH are important to understand. Thus, the next section provides a different angle of view on financial markets, taking a supply and demand interpretation. By viewing financial markets from this angle, the anomalies of the EMH might be better explained and thus we can start to understand dividend price pressure’s place in markets theory.

## 2.4 Supply & Demand for Financial Markets

Anomalies to the EMH, such as the ones discussed in the previous section, might be driven by effects not covered in the EMH-view of financial markets. In this regard, it is worth reviewing how other theories on market reactions might help enlighten these cases. While we in the previous section provided examples of anomalies, we here extend on these with an interpretation of the underlying dynamics at work, using a supply and demand approach. As such we introduce the concept of price pressure as a shift in market demand.

Analyses using supply and demand to enlighten how markets react to changes are broadly used in economics. For financial markets however, the idea can be confusing, as the classic literature, such as the one reviewed in the previous section, assumes that prices to at least some extent are efficient and thus should be anchored to the fundamental value of a company. In a recent paper by David H. Solomon and Samuel M. Hartzmark (2021), the argument is made, however, that financial markets also should be possible to analyse using supply and demand.

When studying markets in general, supply and demand are mapped by using the price and quantities of a given good. As the price falls, demanders of the good are willing to buy more, whereas suppliers reduce the quantity they are willing to provide. In other words when mapping quantity on the x-axis and price on the y-axis, the supply curve is upward sloping, and the demand curve is downward sloping. Quantity and price are thus mutually dependent and are able to change based on market conditions (Goolsbee et al., 2016). However, when the good in question is a stock, this framework is not necessarily representative.

As Shleifer (1986) argues, the quantity of a stock is generally fixed, meaning that the supply curve must be vertical. This is logical as the company supplies the same number of stocks[10] regardless of price. However, since all stocks must be owned by an investor, the quantity at any equilibrium price must also be fixed to the same amount. Thus, in order for prices to increase (decrease), the demand curve itself must shift "up" ("down") (Hartzmark & Solomon, 2021). As we know, shifts in the demand curve represent exogenous shocks to demand. Thus, the actual price setting element of this model is exogenous, i.e., how investors actually agree on a price when exchanging a single stock, is not captured. This is a confusing concept where the demand curve only represents the net effect of all buyers minus all sellers, and hence price pressure is even harder to comprehend in this setting. Hartzmark and Solomon (2021) therefore turn to their alternative conception, considering supply and demand in terms of "people bringing trades to the market" (Hartzmark & Solomon, 2021, p. 7).

In this alternative approach, Hartzmark and Solomon (2021) suggest that supply is given by the number of willing sellers of a stock at a given price, and that demand is the number of willing buyers, thus to an extent mirroring the limit order book[11]. In this setting, the supply and demand curves are downward and upward sloping respectively, as in the standard representation of supply and demand. The dynamics of how the price of a stock is set is now easier understood. Investors who wish to buy at the current price would enter buy orders, representing demand. These buyers fulfil their order by receiving stocks from those who have

[10] Supply of stocks is in this case equivalent to shares outstanding.

[11] "Represents a collection of buy and sell orders placed by traders at a variety of price points" (Libman et al., 2021)

placed sell orders, representing supply. In this setting, interpretation of price pressure is more intuitive.

In order to understand price pressure in the framework above, for instance upward price pressure, we can imagine how the demand curve would shift as a result of some shock that increases the willingness to pay for a stock. This increased demand means that for any given price there are now more buyers than was before, i.e., the demand curve shifts "out". As a consequence, sell orders at the lowest supplied price point will be filled quicker (than before), and buyers who are still demanding stocks will then try to fill at subsequently higher price points. This process continues up to a price point where balance is restored between buyers and sellers (Goolsbee et al., 2016)[12]. Thus, the price has increased.

As of now we have only theoretically discussed the idea of supply and demand and how price pressure might occur and create what the EMH labels as anomalies. With Hartzmark and Solomon's (2021) supply and demand interpretation of stock markets, anomalies such as the ones described during the discussion on efficient markets, may be better explained. However, we lack an understanding of how price pressure comes about and if it is reflective of the real world. In the next section we will therefore introduce a paper by Xavier Gabaix and Ralph Koijen (2021) that studies some underlying market dynamics that may not be accounted for by EMH. This paper could help shed light on the assumptions behind what might create price pressure. Thus, when building on Hartzmark and Solomon's (2021) supply and demand view of markets, some of the "dark matter", or as Fama puts it "unidentified risks", surrounding market studies based on the EMH can be cleared up.

## 2.5 Assumptions from the Inelastic Market Hypothesis

In 2020, Xavier Gabaix and Ralph Koijen (2021) (hereby GK) published their first take on what they termed the "Inelastic Market Hypothesis" (hereby the IMH). They have later published their full account of this theory in their paper *The Origins of Financial Fluctuations*. Here, they hypothesise that markets are inelastic, exemplified by their calculation that a $1 inflow to the market increases the aggregate market value by $5. Their discovery is potentially

[12] This source explain how general shifts in demand are explained in the framework and note that the particular stock price application cannot be sourced to them

ground-breaking, as it deviates drastically from previous assumptions regarding the market under the EMH, where prices are supposed to be relatively elastic (Loderer et al., 1991). Though this thesis will not be covering elasticities, Gabaix and Koijen's (2021) view that the market exhibits inelastic macro demand, and the assumptions behind the hypothesis, are important. Their idea implies that the market can be analysed using supply and demand and thus that price pressure can exist. The supply and demand model of the market, as discussed by Hartzmark and Solomon (2021), thus resonates well with Gabaix and Koijen's (2021) hypothesis. Hence, GK's assumptions on the characteristics of the market are highly relevant when arguing how and why price pressure occurs. In this section these assumptions will be presented.

When Gabaix and Koijen (2021) present their theory, they lay an emphasis on the concept of flows[13] to and from the stock market as "idiosyncratic" shocks to market demand. When the flows occur, the result is that the aggregate market moves by more than the initial flow. They believe this comes as a consequence of certain assumptions. Firstly, a lot of investors are constrained in their actions, meaning they typically hold investments, and buy (sell) the same market when inflows (outflows) occur. Considering that these typical investors trade with each other, when someone for instance want to buy, they must buy them off someone who wants to hold, thus creating price pressure. Secondly, they highlight that the arbitrageurs who supposedly take the opposite position of these investors, i.e., conduct offsetting trades, do not do so according to evidence. As such, adjustment of prices back to fundamental values does not happen, and furthermore, might even fuel further deviation from its fundamental values. Put together, the result is that the market moves by more than the initial flow to or from the market. To understand why Gabaix and Koijen (2021) believe that flows translate to demand shocks and price pressure as explained, it is critical to understand these implied assumptions.

Firstly, we discuss the assumption that the typical stockholder is constrained in their actions. Gabaix and Koijen (2021) provide numbers on market shares for different types of investors. Generally, they find that mutual funds and other similar investors[14] have a large market share, with about 35-45% of the US market. When these funds deploy invested money into the

[13] Net inflow or outflow of cash in different asset classes (Chen, 2020)

[14] This includes mutual funds, ETFs, and various pension funds

market, they typically do so under strict mandates. Furthermore, they argue that retail investors typically exhibit similar behaviour, with a high equity share over time and little variation, adding another ~30% of the market share in the US. In total, this means that investors who abide by strict mandates, or at least exhibit that same behaviour anyway, make up a large portion of the market. As such, their assumption that a lot of investors are constrained in their actions seems to be valid, i.e., supporting a dynamic where typical investors can induce price pressure or opposite. Taking mutual funds as the textbook example, GK argue that whenever a mutual fund has an inflow of cash, they must deploy this cash in the market in accordance with its mandate regardless of current prices. Similarly, they must hold on to these stocks when other investors wish to buy, meaning that supply is limited. When seen from the supply and demand perspective, the effect of such behaviour in the market is that inflows drive prices up and outflows drive prices down on the aggregate level, all else equal (Gabaix & Koijen, 2021).

The second critical assumption of Gabaix and Koijen (2021) tackles a potential argument against the above. Whenever prices are forced as a result of flows and strict mandates, typical arbitrageurs should off-set this effect if they believe prices are fundamentally wrong. For instance, hedge funds surely must understand that prices are deviating from fundamental values and engage in precisely the off-setting trades that the EMH predicts. However, GK argue that it simply is not possible for hedge funds or other arbitrageurs to trade enough to off-set these effects. This is because, as per their research, hedge funds' share of the US market is less than 5%. Also, they question the assumption that hedge funds' trades would necessarily be in the "off-setting" direction in the first place (Gabaix & Koijen, 2021). This is supported by Brunnermeier & Nagel (2004), who found that hedge funds did not engage in corrective trades during the technology bubble in the early 2000s. Gabaix and Koijen (2021) argue further that hedge funds for instance tend to reduce equity holdings in bad times due to liquidity constraints following investors' withdrawal of cash, and also due to binding risk constraints. Hence, they argue that the pressuring effect on prices driven by mandate constrained investors will not be offset by arbitrageurs (Gabaix & Koijen, 2021), which is in contrast to what the EMH predicts.

Gabaix and Koijen (2021) provide further assumptions that support their hypothesis of inelastic markets. For the sake of this thesis, we deem the two that are covered above as the most critical with regard to a study of price pressure. As a side note, having laid the assumptions above, Gabaix and Koijen suggest that their study of flows has implications that can be broadly utilised. For instance, they show how their hypothesis might change the view on a number of finance issues, such as government policy on quantitative easing and the assessment of share buy backs versus dividend payments in corporate finance (Gabaix & Koijen, 2021).

Hartzmark and Solomon's (2021) supply and demand interpretation of the stock market and Gabaix and Koijen's (2021) hypothesis on flows affecting price pressure under certain critical assumptions, creates a framework that can help explain some of the anomalies that occur in the efficient market hypothesis. The flows in and out of the market that Gabaix and Koijen (2021) study can come in various forms, both correlated and uncorrelated with fundamental values. The next section will use this distinction to explain different types of exogenous demand shocks and thus create a testable approach to understand how markets should be interpreted.

## 2.6 Price Pressure & Dividend Payouts

We have now covered a setting in which we can study flows to the market in the context of price pressure and market anomalies. Having presented various theories on how to interpret the market, this section will discuss how it can be tested. As such, we will first discuss the types of flows, and their usability in this context, and set the basis for what characteristics the flows must have in order to provide a researchable theory. As we shall see, one such flow is dividend payments, and hence we will also specifically discuss this particular case.

Market flows, such as those Gabaix and Koijen (2021) discuss in their paper, can come in various forms and provide shifts in the aggregate market demand in a supply and demand view on markets. For example, if corporate taxes are reduced, this might change the fundamental outlook for companies, and possibility for increased earnings. One would now expect that more people would like to invest their money in stocks, and that investors have higher willingness to pay, thus providing an inflow to the market. Per the supply and demand theory, stock prices should increase as a result of this fundamental change. However, flow to the market can also come from causes not directly related to company fundamentals. As an example, if banks lower interest rates on mortgages, this frees up cash in households that potentially can end up being invested in the stock market. Anyhow, if markets abide by the assumptions presented in Gabaix and Koijens paper, these flows into the market will create price pressure regardless of their origin.

With the argument above, inflows create price pressure and increases in stock prices. However, the discussion of whether this is in line with the financial markets theories we have discussed depends on the nature of the flows. For instance, the EMH states that stock prices should efficiently reflect fundamental information. Thus, one would expect prices to increase on news regarding corporate taxes being lowered, and it would not be regarded as an anomaly. However, if there are flows into the market that are uncorrelated with company fundamentals, the EMH predicts that no price change will occur because arbitrageurs will off-set any deviations from fundamental values. This differs from the supply and demand view of markets and Gabaix and Koijen's (2021) research, as these theories suggest that prices will in fact increase, and that the off-setting effects predicted by EMH do not occur. Thus, there are conflicting views on how flows are incorporated into market prices whenever the flow in question is exogenous or uncorrelated with company fundamentals. In order to test what actually happens, one thus has to find a type of flow that is testable and uncorrelated with company fundamentals.

Hartzmark and Solomon (2021) suggest that a flow that fulfills the criteria mentioned above can be found via the reinvestment of corporate dividend pay-outs. They argue that days with higher total dividend pay-outs should lead to larger market inflows. They base this on Gabaix and Koijen's (2021) assumption that mutual funds have a large market share and strict mandate, and thus provide large dividend reinvestments. In their paper, they specifically test whether a day with higher total cash dividend payment exhibits larger price movements (abnormal returns) than other days. Furthermore, Hartzmark and Solomon (2021) argue that this flow is completely uncorrelated with company fundamentals. Thus, if returns are higher on these days, price pressure, as in a supply and demand interpretation of the market, might be well suited as an explanation for price movements, and perhaps account for anomalies in the EMH. However, this method rests on certain assumptions that need to be addressed.

The first assumption is that the dividend pay-outs are uncorrelated with company fundamentals. This might surprise someone but can logically be elaborated on. The process of a dividend issuance for publicly listed companies consists of 3 important dates. Whenever a company decides to pay dividends, it announces this in a stock exchange announcement[15]. This event is very much correlated with company fundamentals as the announcement provides

[15] A public announcement of, until now, private company information.

new information to the market. Thus, on announcement of dividends, it is likely that one will see a flourish of trading activity as the news is digested by the market (Pittet, 1972). The second significant date in the dividend timeline is the ex-date. This is the first date at which the stock trades without a claim to the announced dividend payment (Heath & Jarrow, 1988). In other words, for an investor to receive the dividend, they must own the stock on the trading day before this date. The ex-date is also correlated with fundamentals. One usually sees that stock prices adjust by the size of the dividend on this day, naturally because the stock is less worth as it no longer includes the announced dividend (Campbell & Beranek, 1955). Finally, the pay-date is the date on which the holders of the stock before the ex-date actually receive their cash payment (Hayes, 2021).

As Hartzmark and Solomon (2021) argue, there is no new information regarding company fundamentals that is announced on the pay-date, and cash that is paid out contains no new information either. All information regarding the dividend is already disclosed and the dividend payment date comes weeks after the ex-date. However, the cash paid out means that investors do receive a very real increase in cash holdings. This means that if all this excess cash is reinvested it does create an increased inflow to the market. As we now see, this increased inflow cannot be due to company fundamentals as it specifically comes from cash with no new information attached, i.e., the dividend payment. Notably, given that investors generally hold diversified portfolios, at least institutional investors, this increase in cash is reinvested in all companies in the portfolio, and not only the company that paid the dividend (Hartzmark & Solomon, 2019). Thus, one might expect aggregate market values to increase given that Gabaix and Koijen's (2021) assumptions hold. However, this inflow hinges on the second important assumption, namely that a sufficient number of dividend recipients do in fact reinvest the cash paid out to them (Hartzmark & Solomon, 2021).

When reviewing this assumption, it is helpful to seek out what earlier studies find about reinvestment rates and the timing of these. It is implausible to expect a 100% reinvestment rate across all investor groups and probably at the group level as well. When dividends are received there are some alternatives to what one could do with it, e.g., hold cash, consume, invest in other markets or reinvest in the stock market. The preference across investor groups in the stock market varies. For instance, retail investors have a preference for consuming their dividend payments (Baker, Nagel, Wurgler, 2007). This is supported in results found by Hartzmark and Solomon (2021) who report very low reinvestments by retail investors, thus setting their assumption to zero percent. As for institutional investors, the literature generally does not distinguish between different investor groups when discussing reinvestments.

Though it is unreasonable to expect a 100% reinvestment, most institutional investors reinvest dividend payments to some extent because "cash is unproductive" (Schmickler, 2021). However, literature usually elaborates specifically on mutual funds (Schmickler, 2021; Kvamvold & Lindset, 2017; Hartzmark & Solomon, 2021), as they make up 22% of the US equity market (Gabaix & Koijen, 2021; Hartzmark & Solomon, 2021). Hartzmark and Solomon (2021) find that at large, mutual funds reinvest the dividends they receive, but to which extent varies throughout the year due to taxes[16], at least in the US. They further find that mutual funds reinvest in the range of 45-69% of the dividend they receive.

As a complicating matter, timing of reinvestment is hard to judge, though one can reasonably assume that an attentive investor would reinvest fairly quickly after receiving the dividend. There could be many reasons as to why the timing differs between investors. It could for example depend on how attentive you are of receiving the dividend or how your brokerage handles the dividend payment. When testing how returns are affected by large dividend pay-days, Hartzmark and Solomon (2021) provide return statistics for multiple days after dividend payments. They remain agnostic as to which day is expected to yield the largest returns. This is due to the differing timing of investors' reinvestments (Hartzmark & Solomon, 2021).

While we have largely covered assumptions and reasons for suspecting there could be price pressure from various flows, and especially dividends in our case, we have not yet provided any evidence. Ogden (1994) has shown how a dividend payment results in abnormal returns for the company who has paid the dividend. Hartzmark and Solomon (2021) further extends this into the aggregate market, where they show a significant effect in market returns on the five days with the largest aggregate dividend payments in their base example. Their results get stronger as they add logical control variables, such as year-by-month fixed effects. Furthermore, both Kvamvold and Lindset (2017) and Schmickler (2021) investigate the relation between dividend payments and dividend paying stocks, as well as spill over effects from dividend payments to non-dividend paying stocks. Their results suggest strong positive correlation between dividend payments and dividend paying stocks, as well as a spill over

[16] Funds often pay out dividends to investors by the end of the year to avoid corporate income tax (Hartzmark & Solomon, 2021).

effect to non-dividend paying stocks. Though Chen (2020) mainly focuses on inflows from cash-mergers, the results are in line with other papers studying cash inflows, namely a strong positive correlation. The research provided shows significant results from price pressure, and mainly dividend price pressure.

# 3. Qualitative Analysis of Applicability in Norway

## 3.1 Introduction

In this section we intend to conduct a qualitative analysis of the Oslo Stock Exchange for potential exposure to dividend price pressure. We do this as part of understanding why or why not we would expect the same results as found in the American market. Firstly, characteristics of the Oslo Stock Exchange will be provided. Secondly, we assess the relevant characteristics of the Oslo Stock Exchange against the assumptions elaborated on in our theoretical framework regarding dividend price pressure. Thirdly, we discuss implications of other characteristics of Oslo Stock Exchange. The analysis will be rounded off with an assessment of the Norwegian market's exposure to dividend price pressure.

## 3.2 General Remarks

The major American stock exchanges are the NYSE and NASDAQ. They had a market capitalization of approximately $22.3 trillion and $19.3 trillion as of January 2021 (Statista, 2022), respectively. The market capitalization of the Oslo Stock Exchange was as of January 2021 approximately $0.3 trillion (See figure 5), considerably less than the NYSE and NASDAQ. Furthermore, the number of companies on the exchanges are approximately 2,900 on NYSE, 3,300 on NASDAQ (Statista, 2022) and 210 on Oslo Stock Exchange (Pareto Securities, 2021) as of 2020. Unsurprisingly, the difference in size is large, and it may boast differences from which we might suspect have an effect on the results we can see on the Oslo Stock Exchange.

When looking at the investor composition at the stock exchange[17], there are some key things to note. Firstly, mutual funds make up only 7% of the investors on Oslo Stock Exchange. However, the foreign investor category makes up 39.2%, and probably represents private investors, nominee accounts, hedge funds etc., but also international mutual funds. As such, the proportion of mutual funds is probably larger than what is given by data from Oslo Stock Exchange in 2019. Another way in which Oslo Stock Exchange is different, is the amount of

[17] See Appendix A

state ownership of listed companies. In fact, some of the larger companies on the exchange are owned between 34-67%[18] by Norwegian governmental institutions. Equinor, the largest company on the exchange is owned approximately 67% by the Norwegian Ministry of Trade and Industry (Statens Eierrapport, 2021).

Lastly, there are differences to account for as a consequence of the size differences and the industry composition of the exchanges. Historically, the Norwegian economy has been heavily dependent on the oil industry because of how much it contributes to public spending ability, economic outlook and the large employer the industry is. Thus, it comes as no surprise that the largest and many of the larger companies listed on the Oslo Stock Exchange are Exploration & Production companies, or companies operating in oil related industries.

## 3.3 Assessment of Oslo Stock Exchange Characteristics

The above section lays the ground for further investigation into the reasonability of whether assumptions for the existence of dividend price pressure on Oslo Stock Exchange are met. One might infer that there could be distinctions that inhibit our ability to apply the assumptions, consequently leading to an inability to effectively test for dividend price pressure in our quantitative analysis.

The two critical assumptions for dividend price pressure to exist is reinvestment of dividends and a relatively inelastic supply of stocks. As such, it is relevant to include the assumptions of Gabaix and Koijen regarding what causes inelasticity, and the assumptions of Hartzmark and Solomon regarding reinvestment of dividends. It is under these frameworks that the Oslo stock Exchange characteristics are discussed.

The first characteristic we handle is the size of the Oslo Stock Exchange. As such it is relevant to look at the number of days where dividends are paid. The number of dividend paying days as a percentage of trading days is 90% for selected US stock markets, according to Hartzmark and Solomon (2021). That is more than twice the percentage for Oslo Stock Exchange[19]. Such differences can come from how often the companies on the exchanges prefer to pay dividends,

[18] See Appendix B

[19] See Appendix D

number of companies and the composition of the companies on the exchange – the biggest factor probably being the number of companies. The impact of this is that the likelihood of companies paying dividends on the same day is smaller on Oslo Stock Exchange, leading to fewer days with large concentrated dividend payments and as such less potential for price pressure from dividend reinvestment.

Furthermore, the small size of the Oslo Stock Exchange warrants a discussion of whether mutual funds reinvest dividends in the same manner as for the American exchange. For Hartzmark and Solomon's (2021) study of dividend price pressure in the US, the assumption that mutual funds passively reinvest dividends into a fixed portfolio on the same market is a critical one, as it ensures frequent and predictable dividend reinvestments. While you would suspect that mutual funds behave the same way in Norway as in the US, this cannot be said for certain. Since the Oslo Stock Exchange as of the end of 2020 is only 1.3% of the NYSE and 1.6% of the NASDAQ, in terms of aggregate market capitalization, it might be unreasonable to expect that international asset managers have mutual funds with specific mandates to exclusively invest in companies listed in Norway – except for Nordic based mutual funds. Rather than that, we believe that it is more likely for them to have "Nordic funds" or "Northern Europe funds" which cover the major stock exchanges of the region. As such, dividends from companies listed on the Oslo Stock Exchange might not be reinvested in the same stock market and are perhaps rather invested across the major Nordic exchanges. Therefore, the effect of dividend reinvestments on the Oslo Stock Exchange might not be of the same magnitude as that of the American ones. As documented by Hartzmark & Solomon (2019), dividends are reinvested broadly, and they therefore also predict that dividend price pressure is not only limited to the stocks that paid the dividend. Investigation into spillover effects done by Kvamvold and Lindset (2017), shows evidence supporting this[20]. However, when reinvestments are so broad that they might not be on the same exchange, the likelihood of observing dividend price pressure becomes smaller.

The second characteristic we handle is the large state ownership on Oslo Stock Exchange. From this, there are two particularly interesting effects on the potential for dividend price pressure. 1) The state does not reinvest the dividends received (Nærings- og

[20] Kvamvold and Lindset (2017) find that spillover effects from dividend-paying stocks likely affects non-dividend-paying stocks in the same benchmark portfolio.

Fiskeridepartementet, 2020) and 2) The state does not trade and adjust their positions in the same way or as much as professional investors.

As with the discussion regarding how mutual funds might not actually reinvest dividends from Norway in the Norwegian market, the first implication of state ownership is that it reduces the size of potential inflows. The government does not reinvest the dividends received from their investments on the Oslo Stock Exchange. In fact, the Norwegian state's yearly budget receives the dividend contributions from these companies. (Nærings- og Fiskeridepartementet, 2021). Consequently, with the government being such a large investor, a substantial amount of the potential inflows are absent, as such diminishing the effect of dividend price pressure on any given day with dividend payments from state owned companies.

The second implication of state ownership especially concerns the free float on stocks, and thus the elasticity of the market. The government is not meant to be a trader[21], nor is it meant to be a regular professional investor. With large ownership they ensure that the companies will act diligently, and they can keep control of some of the actions of the company. Thus, government re-positioning in stocks is very limited, in practice resulting in fewer available shares for trade in the companies with government ownership. If the government owns 30% of a stock, and the rest of the stocks are held by small investors who reposition their holdings on a regular basis, the free float of shares would effectively be 70%. Knowing this, the real supply of stocks will be relatively lower in these companies, all else equal. Additionally, when the companies in question are among the largest on the exchange, the effects on the exchange in general we should suspect to be larger. This can potentially counterweight some of the effect that reinvestments from mutual funds on the Oslo Stock Exchange are smaller compared to that of the Americans. Data on this is very limited and it remains an area of significant interest. Yet, we find it unrealistic that the reduced free float should counterweight the whole effect of fewer reinvestments on the Oslo Stock Exchange.

With regard to the discussions above, we also consider potential arbitrageur behaviour on Oslo Stock Exchange. This is relevant because potential arbitrageurs might engage in off-setting trades to those of the potential uninformed dividend reinvestments. Revisiting the overview of

[21] A trader is an investor that frequently changes its position of stocks

investors on the Oslo Stock Exchange[22], it is hard to derive how large a fraction typical arbitrage investors make out. We do not have access to data that reveals the size of this investor group, however there is no reason to expect the investor group to be a larger portion of the investors on the Oslo Stock Exchange than in the US. Yet, there are large individual private investors present who are known for trying to exploit the same anomalies as hedge funds and other arbitrageurs. This however does not seem to warrant a different conclusion than for the American case regarding the assumptions of Gabaix and Koijen (2021), namely that arbitrageurs are only a small fraction of the investors. There are large private investors in the US as well, who also adjust positions frequently.

## 3.4 Other Aspects of the Oslo Stock Exchange

Another aspect that might deter results further away from potential dividend price pressure is the material effect the oil price drop in 2014 had on dividends. The aggregate dividend payment yield on the Oslo Stock exchange has not yet (as of 2020) reached the same heights as 2014, before the oil price drop. This might seem odd, as one would assume that stock prices also fall with more or less the same relative amount. This would then mean that aggregate dividend payment yield remains approximately the same. However, the actual data[23] shows that the aggregate dividend yield in 2020 is down 1.7 percentage points from the record of 2014 and that it is 0.43 percentage points below the average of the last sixteen years. This materializes to a 41% and 15% drop, respectively. Hence, with lower dividends after 2014, this period might be less prone to price pressure from dividend reinvestments than the periods where oil prices are high.

With the large amount of oil related companies on the exchange, and rapidly changing oil prices, Oslo Stock Exchange is likely affected by oil prices. Furthermore, indirect exposure for publicly listed companies can occur. For instance, large loans from listed banks, change in demand for supplier products and change in local spending by these oil companies can all have an effect. Therefore, through large direct and indirect exposure to the oil industry, the Oslo Stock Exchange might be expected to be relatively dependent on development in oil outlook

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[22] See Appendix A

[23] See Appendix C

and oil price. Coupled with fewer companies on the exchange, resulting in less diversification of the exchange one might expect the exchange to be relatively more dependent on oil outlook and oil price than other exchanges. As earlier noted, findings support the notion of correlation between the Oslo Stock Exchange and the oil price. The impact could be lower investments into companies listed on Oslo Stock Exchange, and the money received from dividends going elsewhere.

## 3.5 Qualitative Assessment

By the above discussion on potential for dividend price pressure, there seems to be no reason to have greater expectation for dividend price pressure than for the American market. Notably, the perceived small fraction of mutual funds who exclusively invest on Oslo Stock Exchange deter our expectations for larger dividend reinvestments, which is a critical part of dividend price pressure. This is further solidified by the fact that the state, which owns a significant proportion of the total market, also does not reinvest dividends. With only 250 companies on the exchange, where not all pay dividends, it is also unlikely that multiple companies have the same dividend payment date. This affects the size of potential inflows on any given date and in this the potential for dividend price pressure. The result is that the increased demand for stocks seen on days with particularly large aggregate dividend payments in the US, does not occur or not to the same extent at the Oslo Stock Exchange. However, with the state not being an active participant and limiting free float, the Norwegian market is potentially rather inelastic, meaning that the investment environment might facilitate price pressure if reinvestments are sufficient. Overall, we do not expect that the Oslo Stock Exchange is particularly exposed to dividend price pressure.

# 4. Data

## 4.1 Introduction

In order to quantitatively test whether dividend price pressure exists on the Oslo Stock Exchange, we gather and prepare the necessary data. For the purpose of this thesis, it is necessary to find data not only for existing stocks, but also for those that have been on the exchange at any point during the timeframe we study. A large part of forming the quantitative analysis is thus the steps taken when gathering and cleaning the stock data and will be the focus of this section. First, the data gathering process will be described whereby we discuss any important considerations regarding the raw data. Second, we present the cleaning and filtering processes used to prepare the data for analysis. Finally, the filtered and cleaned raw data is presented and summarised. It is important to note that our analysis will use portfolios and aggregations that are calculated based on the individual stock data. The calculations and methods used to obtain the datasets that are used in regression analyses will be elaborated on in the "methodology"- part of the quantitative analysis section. As such, the following focuses only on the raw data of individual stocks and individual days.

## 4.2 Data Gathering and Filtering

The critical data needed for this thesis is historical daily stock price data and dividend payments of companies that have been on the Oslo Stock Exchange at any point in the time frame. It is also necessary that we have the exact payment date of the dividends. As such, we have combined data from two primary sources. Most of the data is obtained from TITLON[24], a financial database on the Oslo Stock Exchange from Universitetet i Tromsø. We have then used ISIN-codes from this database to look up dividend payments and the dividend payment dates using Refinitiv[25].

[24] https://titlon.uit.no/

[25] https://www.refinitiv.com/

When researching various datasets, our main focus was on obtaining the largest possible dataset where we felt that the included set of companies was representable of what a typical investor could invest in at any point in time. Second, due to the requirement that we needed exact dates for the actual payment of dividends, which we found through Refinitiv, the overlap of the data with Refinitiv was obviously a main constraint. Subject to certain limiting factors that will be presented later on, the final dataset is satisfactory for our research.

### 4.2.1 Included Time Frame

When preparing the data for analysis, a number of filters have been applied to the raw data to obtain the goal of a representable set of companies and timeframe. The initial data from Titlon contained observations dating back to as early as 1980. However, issues arose when matching the early Titlon-data with Refinitiv to obtain the necessary dividend data. Therefore, it was decided that the scope of the analysis would be contained to relatively recent data, so that verification of data quality and overlap with the Refinitiv data was satisfactory. The final dataset has its first observations on January 3$^{rd}$ 2005, and final observations on 27$^{th}$ November 2020.

A possible concern regarding limiting the time frame of the data that is used, is that results might not be representable for another, different, time frame or for the Oslo Stock Exchange as a whole. If, for instance, the Oslo Stock Exchange was generally very stable with little volatility, but the specific data you study contains large irregular (unusual for that stock exchange) movements, results from that data subset would be biased if the intention was to draw inferences regarding the market's full timeframe. However, this thesis does not aim to draw inferences on market parameters, but rather test for the existence of a specific trait (Dividend price pressure) in a specific market (Norway). As such, we argue that the potential pit-fall of the above mentioned biases is less relevant in this instance, as the timeframe rather works as further specification to the scope of the thesis. That being said, biases will still affect results, and therefore, as mentioned, the aim was to obtain a dataset we felt was representable for the modern Norwegian market.

We argue that the time frame of the 16 recent years covers a large variety of conditions that the Norwegian market might experience. The 16 years includes for instance major downturns with the financial crisis and Covid-19, but also longer spells of continued growth. In the context of price pressure, we further argue that recent data is advantageous. As we discussed in the theoretical framework, market participation and the distribution of different types of participants is highly relevant. Considering that participation changed drastically with the increased market accessibility that came with computers and the internet from the 1990's and on (Bogan, 2008), it can be argued that data from before this is less relevant for an analysis of whether dividend price pressure exists today.

### 4.2.2 Filters on Stock Characteristics

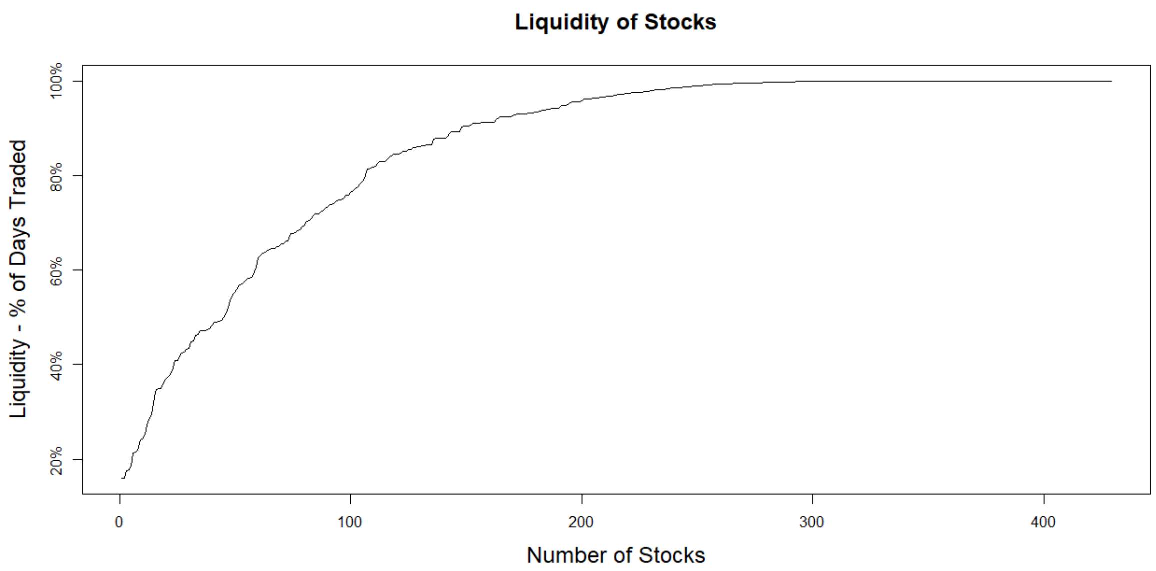
To secure data that is representable for the Oslo Stock Exchange and to avoid double entries of the same company, we include only common shares. In our data this means that we only include *A shares*, *ordinary shares* and *Primary Capital Certificates ("Egenkapitalbevis")*. We include *Primary Capital Certificates* as equals to ordinary common stock as they are listed on the exchange and trade in the same manner. As such we get to include Norwegian saving banks in the analysis. We believe it would misrepresent the Norwegian financial sector not to include these as they are a significant part of the sector. The data includes observations for stocks on both the main exchange Oslo Stock Exchange (OB hereafter) and a secondary exchange Oslo Axess (OAX hereafter). Considering that the OAX is designed as a preliminary listing opportunity for companies that do not meet the requirements to be noted on OB, we do not consider these stocks in the sample. We note however that there are multiple instances where stocks are moved from OAX to OB, in which case the company does indeed enter the dataset, but only when on the OB. Having considered the filters above, the data contains 429 unique stocks throughout.

The data consists of daily observations for each stock. Obviously, the timeframe in which a given stock exists in the data will vary depending on when the company was noted or delisted. However, the data has numerous missing entries, even when a stock is not delisted. For example, a stock might have data registered on a Monday and the following Wednesday, but not for the Tuesday between. These occurrences are because the stock has not traded on the given date. However, we need the daily return of all stocks for the entirety of their existence in the stock market. Therefore, for the dates that a stock has not traded we use the last available data entry to fill in the relevant values such as the stock's price, market capitalisation and number of shares. The return on such a day is hence zero. We make sure to only fill data for stocks where there is data before and after the missing entry to ensure we do not faultily fill data for stocks that are delisted or not yet noted. We keep track of the days that a stock has not traded by setting variables such as volume and number of trades to a default value of 0 and have also marked saved the date from which the data is brought forward.

Having registered the days that each stock trades we can consider the liquidity of the stocks, here defined as the percentage of days where the trading volume is larger than 0. For the purpose of our research it is advantageous that stocks have a high liquidity. This is because we are studying how cash dividends on a given day affects the return, i.e., daily occurrences. If too many stocks have low liquidity, and thus do not trade on many of the days, their return of 0 on those days might skew the return of the market portfolios on which we will measure the effects. However, we are generally careful with imposing larger filters on the data because it may cause unwanted biases. For our data overall (as of now), 86.4% of all the daily stock observations are days where the given stock has traded, which we find satisfactory. On average it means that most stocks will be trading on any given day. We thus decide to not filter based on the liquidity. Although a few stocks that at times trade very seldom are included, we find it advantageous to include them in order to maintain the realistic investment opportunities at various time points, as well as the fact that some of the stocks that would potentially be filtered out actually pay plenty of dividends.

**Figure 1 – Distribution of stocks' liquidity**

The figure shows the liquidity of all stocks in the data. The liquidity is here defined as the percentage of days on the exchange where trading volume is larger than zero.
Source: Data from Titlon



Another consideration we make is regarding the number of days that stocks exist in the dataset. The reason for this is some suspected typos. We see that some of the data seems to belong to stock types we previously excluded. Also, it can be argued that stocks that only are in the data for a very short amount of time will barely have opportunity to provide any dividend payments, nor be included in any market or mutual funds' portfolios. We decide to add a filter that excludes stocks that have been on the exchange less than 100 days. This removes only 15 companies, taking the total down to 414 companies. We believe this adjustment is justified as it probably does not bias results nor deviates the data substantially from the representable investment options at any point.

When calculating the daily returns of all the stocks we see that there are some observations of very extreme returns (for instance ~626% increase or a ~98% decrease). As we will be creating portfolios and use the full 16 years of daily data for analysis, it is unlikely that a single stock's very extreme return observation for one day will affect results to a large extent. This is because the observation is likely to bare little weight in the context of a portfolio's return over 16 years. That being said, we still consider the issue.

In his empirical work with the Oslo Stock Exchange, Professor Bent Arne Ødegaard (2019, Ødegaard hereafter) points out that low valued stocks (penny stocks), which he defines as a stocks priced below 10 NOK, often have very exaggerated returns. He further suggests that penny stocks should be removed. In our data we observe that penny stocks are in fact disproportionately well represented among the more extreme return observations and thus might explain some of the extreme values. However, Ødegaard's studies are mainly focused on asset pricing applications, and opposingly we find it more important to retain as many of the stocks as possible in order to obtain representable data and avoid excluding possible dividend payers. Also, we argue that although penny stocks have more extreme return observations, they are still investment options and will be relevant for studying price pressure.

Nonetheless, with the presence of extreme return observations in our data, we acknowledge that possible actions might be to winsorize or trim the data. However, having observed that penny-stocks might explain some of the extreme returns, and that we in general believe the data to be correct (as we have realized, the Oslo Stock Exchange has contained companies that have exhibited rather extreme volatility), we retain the data as is. Also, considering the argument above that the individual stock returns are unlikely to affect the study at large, we decide to avoid possibly unnecessary synthetic adjustments to the data.

## 4.3 Summary Statistics of Daily Stock Data

The resulting dataset contains daily observations for 414 different companies from 3rd January 2005 to 27th November 2020. The data contains numerous data points on each stock for each day. The average and median lifetime of the stocks in the data is 1914 days (~5.2 years) and 1525 days (4.2 years). The most important variables for our analysis will be those related to dividends and returns. As such, the table below describes this along with the market capitalization, which is needed to calculate weights in portfolios, as well as trading volumes.

**Table 0: Summary Statistics of Daily Stock Data**

The table provides summary statistics of important variables that are contained in our daily stock data. The data was retrieved from UIT's Titlon database and Refinitiv. The data covers the period from 3rd January 2005 to 27th November 2020. *Market Cap* is the market capitalization of a company on a given date. *Trading Volume* is the total cash volume of trades for a stock on a given date. *Dividend* is the gross dividend paid out by a company on a given date. *Shares* is the number of shares outstanding for a company on a given date. *Cash Paid* is the total cash payment, computed as *Gross Dividend * Shares*, for a company on a given date. The *N* column is the total number of rows in the date, i.e., one row for each stock for each day it exists on the market. The *N(obs)* column is the number of observations in the initial raw data, where stocks were registered only if they had traded on the given date.

**Daily Stock Data**

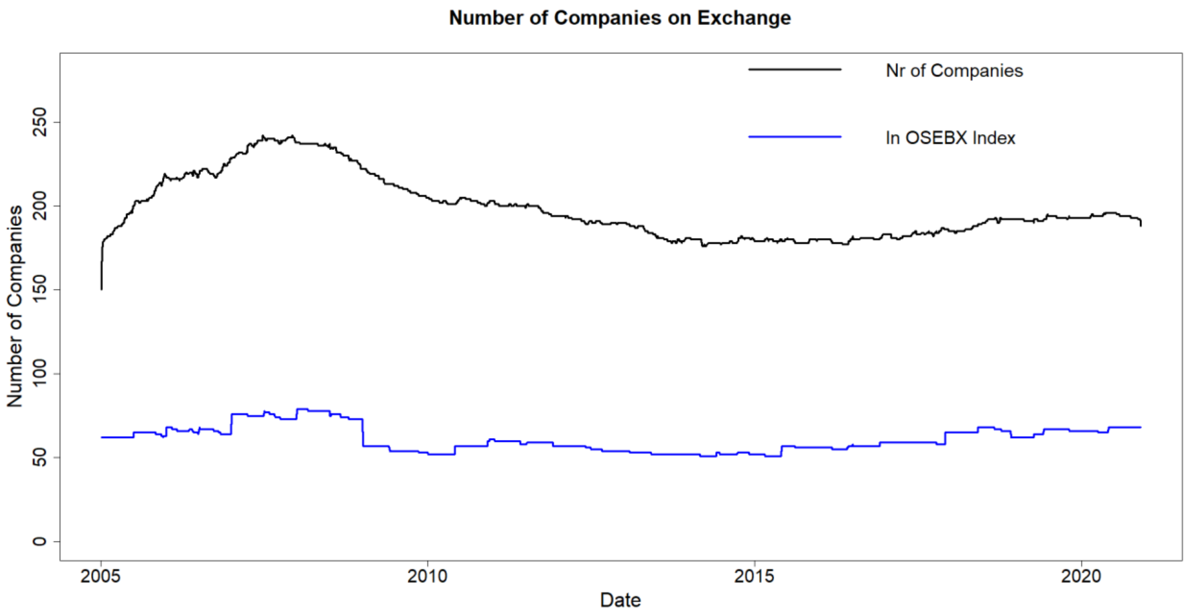
| Variable | N | N(obs) | Mean | SD | Min | Max |
|---|---|---|---|---|---|---|
| Market Cap | 792,382 | 685,042 | 8,838,586,696 | 32,133,869,886 | 713,333 | 503,370,000,000 |
| Trading Volume | 792,382 | 685,042 | 27,223,605 | 128,507,642 | 0 | 16,323,600,000 |
| Dividend | 1,845 | 1,845 | 4.71 | 13.94 | 0.01 | 420 |
| Shares | 792,382 | 685,042 | 177,163,895 | 340,000,116 | 94,768 | 2,147,480,000 |
| Cash Paid | 792,382 | 685,042 | 1,013,748 | 73,949,554 | 0 | 19,517,803,200 |
| Return | 791,966 | 684,626 | 0 | 0.04 | -0.98 | 6.26 |

The data presented here is used to create the portfolios and calculations used in the analysis

Moving on we can take a closer look at some of the features of the final stock sample over the time frame's period. We have in total 414 companies included, but all are not on the exchange at all times. Below we show the number of stocks included in the data throughout the time frame, and also how many that are included in the main OSEBX index.

**Figure 2 – Companies listed on Oslo Stock Exchange and companies included in the OSEBX Index**

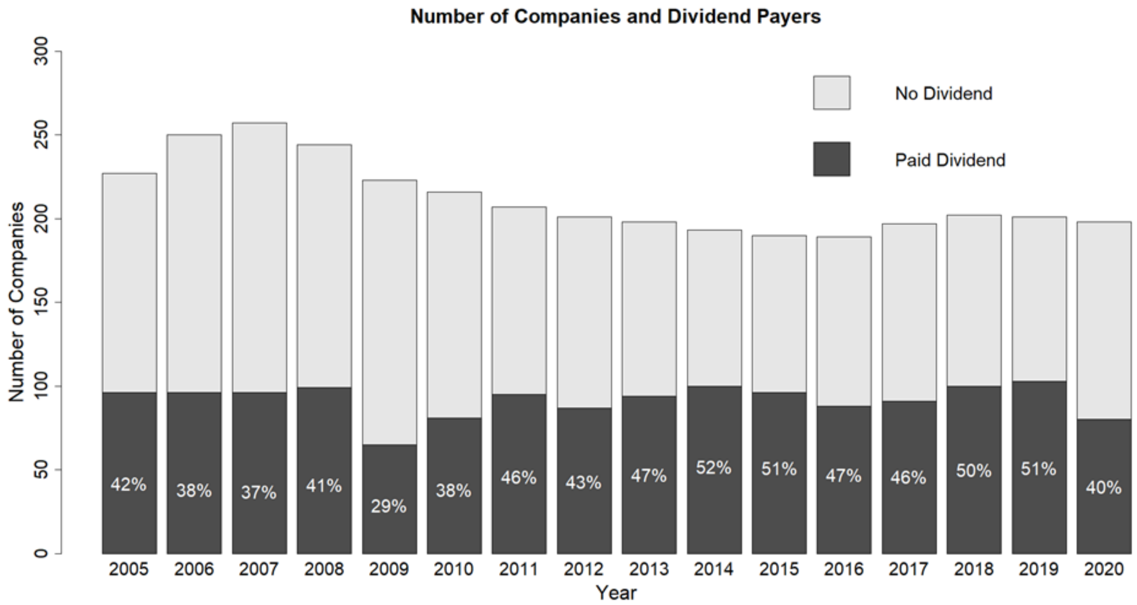
The figure shows the development of the number of companies on the Oslo Stock Exchange through the time frame of our data. The blue line indicates how many companies are included in the OSEBX index, main index of the OSE.
Source: Data from Titlon




Of the companies on the exchange, there is a varying degree of dividend payout frequency. For all companies throughout the data, as seen in the table above, there is a total 1845 observations of dividend payouts. Below we can see the fraction of companies that pay a dividend during each year. The 2020 data may be skewed by the fact that the full year is not included (as the data ends on 27th November), but it is also likely lower due to covid anyhow. Also, keep in mind that included each year are those companies that might be delisted or noted in the given year.

**Figure 3 – Number of companies listed on the exchange and the fraction who paid dividends**

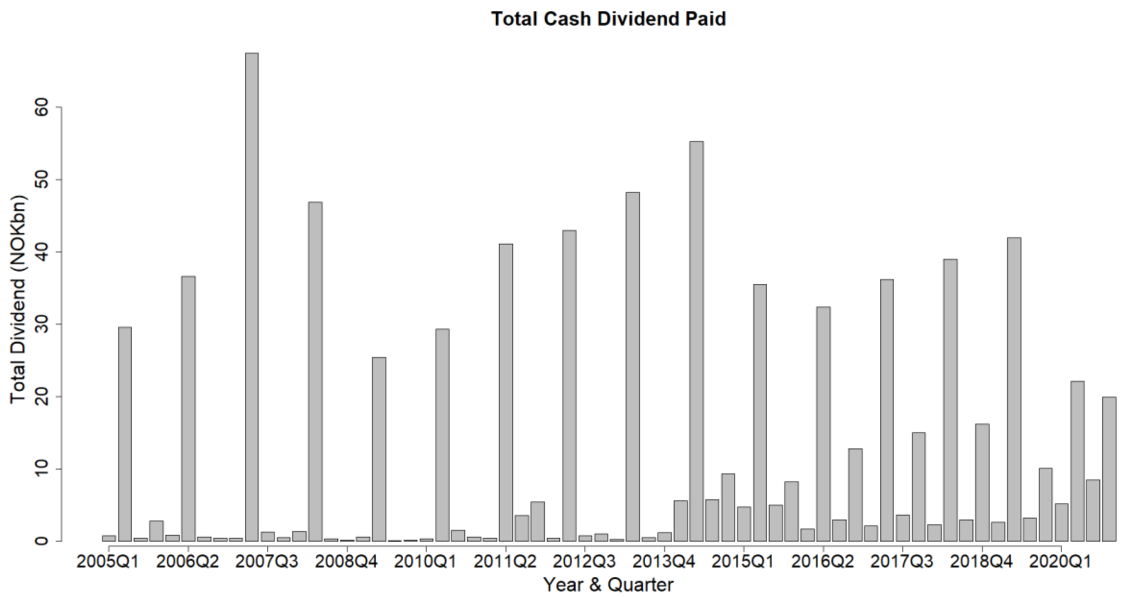
The figure shows the number of companies, and the share of these that pay a dividend in the given year throughout the time frame of our data.
Source: Data from Titlon and Refinitiv




Looking at the distribution of these dividends on a quarterly basis, we can see that the dividends paid out also seem to be rather seasonal, with Q2 typically yielding larger aggregated payouts.

**Figure 4 – Distribution of dividend payments by quarter**

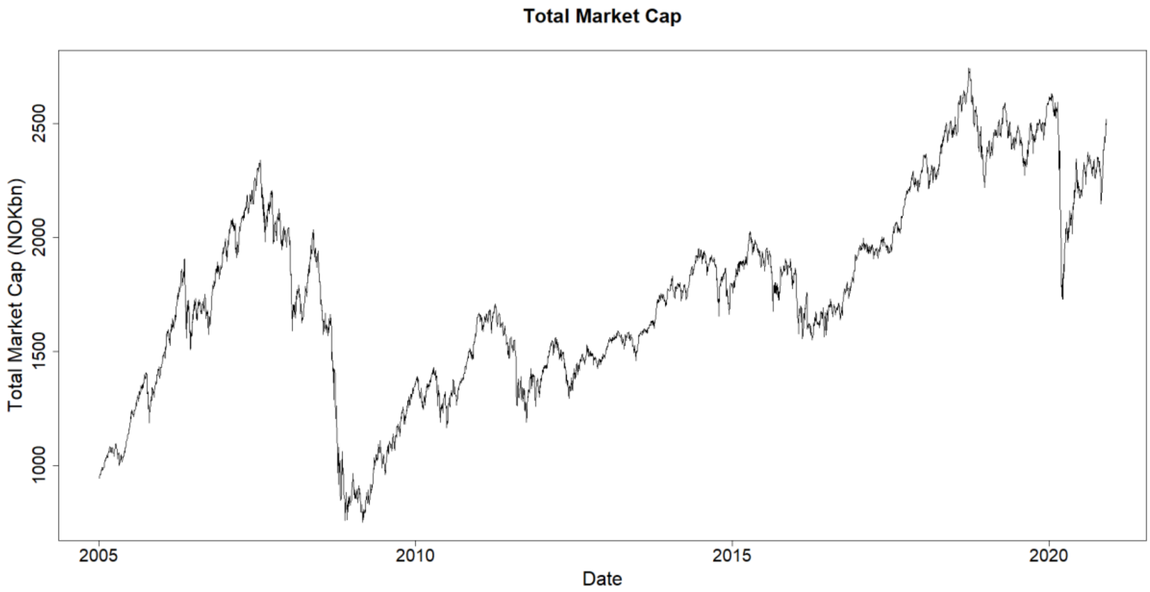
The figure shows size of the aggregated dividend payments from the Oslo Stock Exchange in each quarter throughout the time frame
Source: Data from Titlon and Refinitiv



Finally, we can see that the total market cap of the exchange has increased throughout the time frame, while somewhat mirroring the fluctuations in total dividend payments.

**Figure 5 – Development in Total Market Capitalisation for Oslo Stock Exchange**

The figure shows the development of the market capitalisation of the Oslo Stock Exchange throughout our time frame. We observe clear dips during known crises such as the financial crisis in 2008 and the outbreak of covid-19 in 2020.
Source: Data from Titlon




## 4.4 Other Relevant Data

Finally, we also use data for the whole time period for oil-prices (Brent) and the MSCI world index. Oil-prices are found through the U.S. Energy Information Administration[26], while the MSCI world index is downloaded from the MSCI webpage[27]. We download these for possible inclusion in the analysis, to be used as benchmarks or control variables. The MSCI World Index is included to represent global market movements and outlook, while the oil prices are included because of the discussed connection that the Oslo Stock Exchange has to oil prices. The MSCI World Index captures large and mid-cap representation across 23 developed markets, and is thus a good proxy for the return on global markets.

[26] https://www.eia.gov/dnav/pet/hist/rbrteD.htm

[27] https://www.msci.com/

# 5. Quantitative Analysis on Oslo Stock Exchange

## 5.1 Methodology & Variables

### 5.1.1 Introduction

The final dataset of daily stock observations for Oslo Stock Exchange, presented in the previous section, will be used to assess the existence of dividend price pressure on the Oslo Stock Exchange. This will be done by analysing the relationship between the aggregated daily dividend payment yield and the return of the market portfolio. In short, a positive correlation between the variables may indicate that the added cash investors receive, and assumingly reinvest, drives the market prices up on those days. This section will first explain how the data is set up for the analysis, including portfolio creation and aggregations of the daily data. This will be followed by an explanation of the main variables used in the analysis.

### 5.1.2 Portfolio Creation and Selection – Main Dependent Variable

The main independent factor in the analysis, from which we will be measuring any effects, is the aggregated dividend payment yield. To obtain this, we sum up the total cash payments made by companies for each day and divide by the previous day's total market capitalisation. We use the yield, and not the absolute values of the cash payments to account for the size of the market at any point.

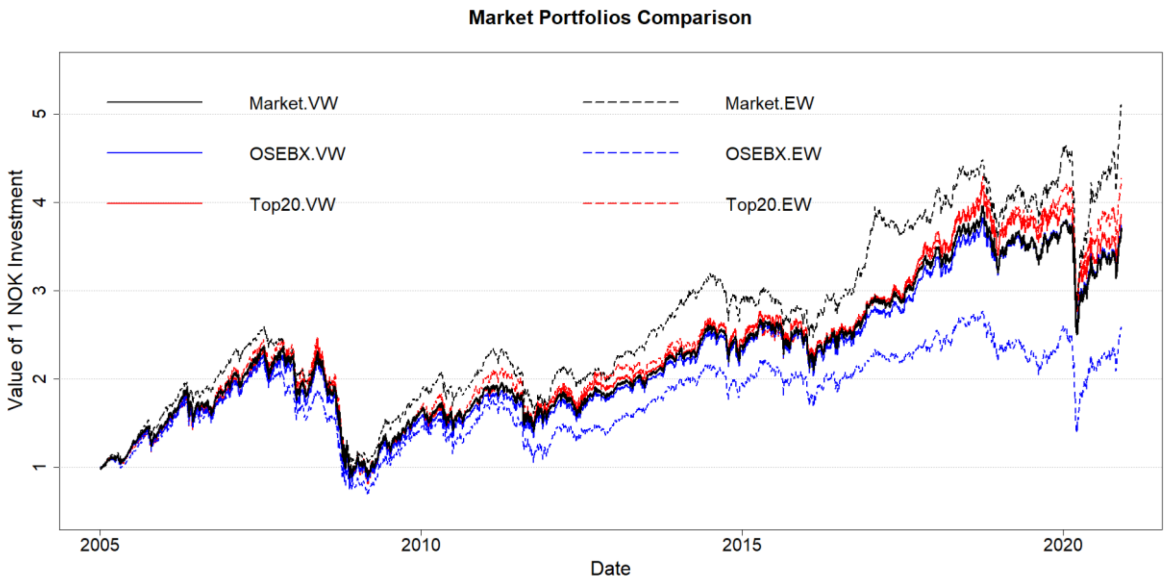
In order to measure how the market reacts to days with higher aggregated dividend payment yield we must have a measure of the reaction. For this we will use the returns from two versions of the market portfolio, which will be the value-weighted and equal weighted market portfolios. We create the value-weighted portfolio by using the previous day's market capitalisation of each stock to determine the weights. Then for the given day, we multiply the weights by each stock's return to obtain the market return for a given day. For the equal weight portfolio, we simply take the average return of those same companies on the same day. As such, our market portfolios are rebalanced on a daily basis, and are our main dependent variables.

Further, for comparison with our choices for the market portfolio above, we consider how other potential alternative portfolios match up. The first is the value weighted portfolio of companies included in the OSEBX-index. This is close to replicating the main index of Oslo

Stock Exchange with the main difference being that the OSEBX-index is not re-weighted on a daily basis (Euronext, 2022). Secondly, we include a value-weighted portfolio of the top 20 companies measured by market capitalisation on the previous day. Finally, we also look at the equivalent equal-weighted portfolios. The plot below shows the cumulative value of a 1 NOK investment in the mentioned portfolios.

**Figure 6 – Comparison of different market portfolios for the Oslo Stock Exchange**

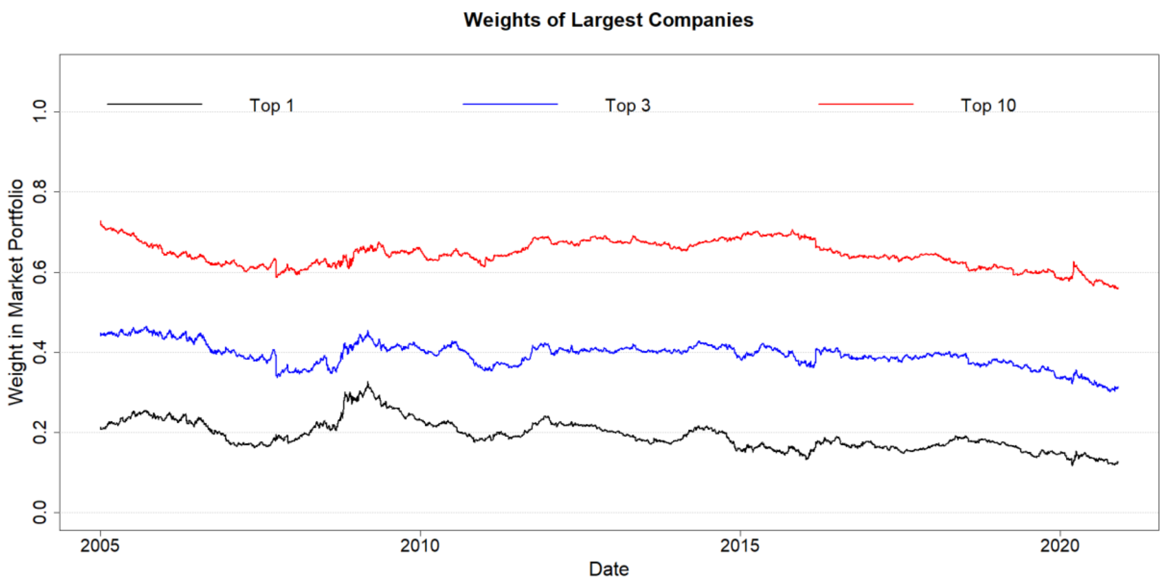
The figure shows how the cumulative value of a 1 NOK investment into different market portfolios develops throughout our time frame. The solid lines are value weighted portfolios while the dashed lines are equal weighted. We will be using the value and equal weighted total market portfolios (the black coloured lines) for our analysis.
Source: Data from Titlon




The chart shows that the value-weighted (solid line) portfolios follow each other closely, while the market- and OSEBX equal weight (dotted line) portfolios are more varying. We can also see that the equal weight version of the Top20 portfolio follows relatively closely the value-weighted portfolios. Considering that the value weighted portfolios all would seem pretty similar, the choice of using the total market value weighted portfolio as our dependent variable makes sense. We consider all stocks on the exchange while the weights take into account how the typical mutual funds and investors invest on average. However, we also include the equal weight market portfolio in our analyses. The reasoning for this comes from understanding why the value weighted versions of the three portfolios are so close. On the Oslo Stock Exchange, the very largest companies make up a large proportion of the total market capitalisation. The figure below shows the proportion that the top 1, 3 and 10 companies make of the total value-weighted market portfolio.

**Figure 7 – Development of Top 1, 3 and 10 companies' share of the total market capitalisation**

The figure shows how the largest, judged by market capitalization, 1, 3 and 10 companies' share in the total market capitalization develops throughout our time frame. As we can see, a few large stocks make up a significant proportion of the total market.
Source: Data from Titlon




As we can see, the value weighted market portfolio is heavily influenced by a few relatively very large companies (e.g., Equinor, Telenor and DNB). This also explains why the equal weighted top20 portfolio is closer to matching the value-weighted portfolios in the previous graph (the top20 equal weight portfolio will be closer to replicating a theoretical portfolio containing only those very large companies). We argue that this characteristic justifies the inclusion of an equal-weighted version of the total market portfolio as well. The goal is to capture the total market reaction, yet the value-weighted portfolio will be extremely susceptible to specific effects in the largest companies. As such, our interpretation of the analyses will rely on a combination of the results from both the value weight and equal weight portfolios.

## 5.2 Variables

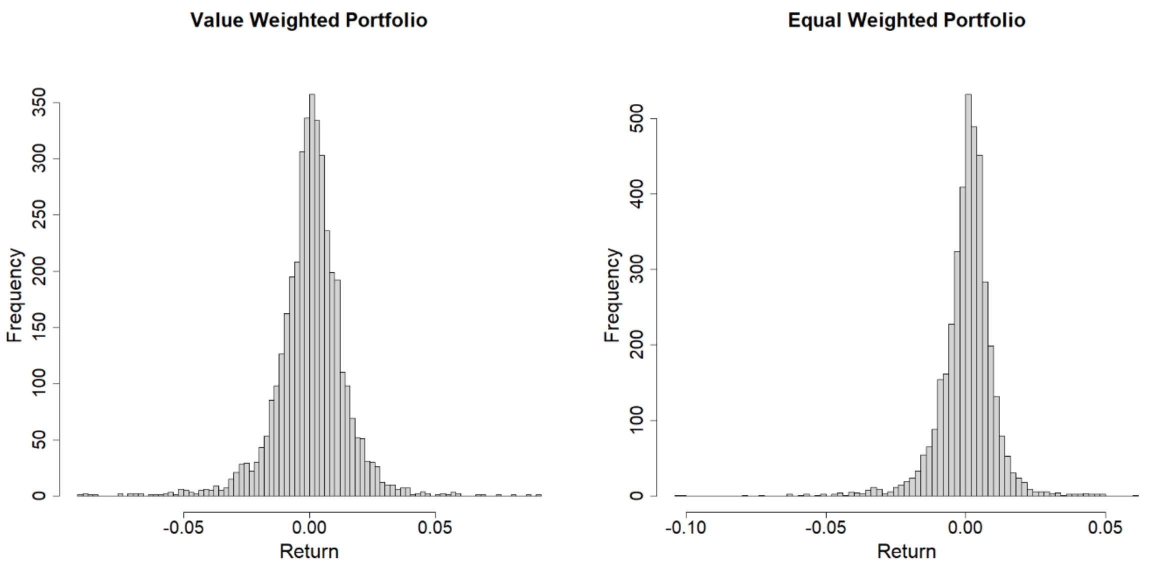
Having selected and justified our main dependent variable, and briefly presented the main independent variable, this section looks closer at the distributions and relationships between these, and also introduces control variables that will be used in the base analyses.

### 5.2.1 Dependent Variable: Portfolio Return (VW & EW)

First, the dependent variable is discussed. The analysis will use both the equal and value weighted market portfolio returns to measure market reactions. The returns are calculated on a daily basis between 3rd January 2005 and 27th November 2020, and include a total of 414 companies throughout that time frame. Below, we can see the distribution of the two portfolios' returns. They are as expected close to normally distributed, while it seems the equal weight portfolio contains a few outliers on negative return.

**Figure 8 – Return distribution for the value weighted and equal weighted market portfolios**

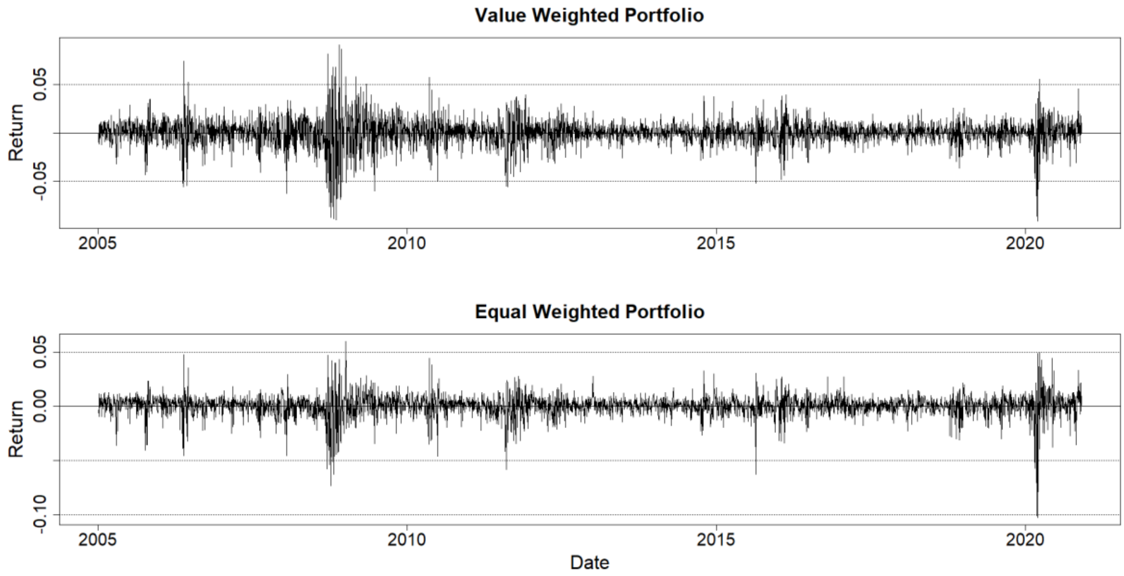
The figure shows histograms of the equal and value weighted portfolio returns.
Source: Data from Titlon




Below, we can spot that there are times with higher volatility that coincide with known major stock market upsets such as the financial crisis in 2008 and the covid-19 outbreak in 2020. We can see that most of the outliers in the histogram above likely can be attributed to these periods, especially for the equal-weighted portfolio. This is something to be wary of, as these observations increase the standard deviation (volatility) of the overall market, and it may be productive to include controls for such effects.

**Figure 9 – Return volatility in studied time frame**

The figure shows the returns of the value and equal weighted market portfolios throughout our time frame. We can see clear spikes in volatility surrounding large known market disturbances such as the financial crisis in 2008 and the outbreak of covid-19 in 2020.
Source: Data from Titlon



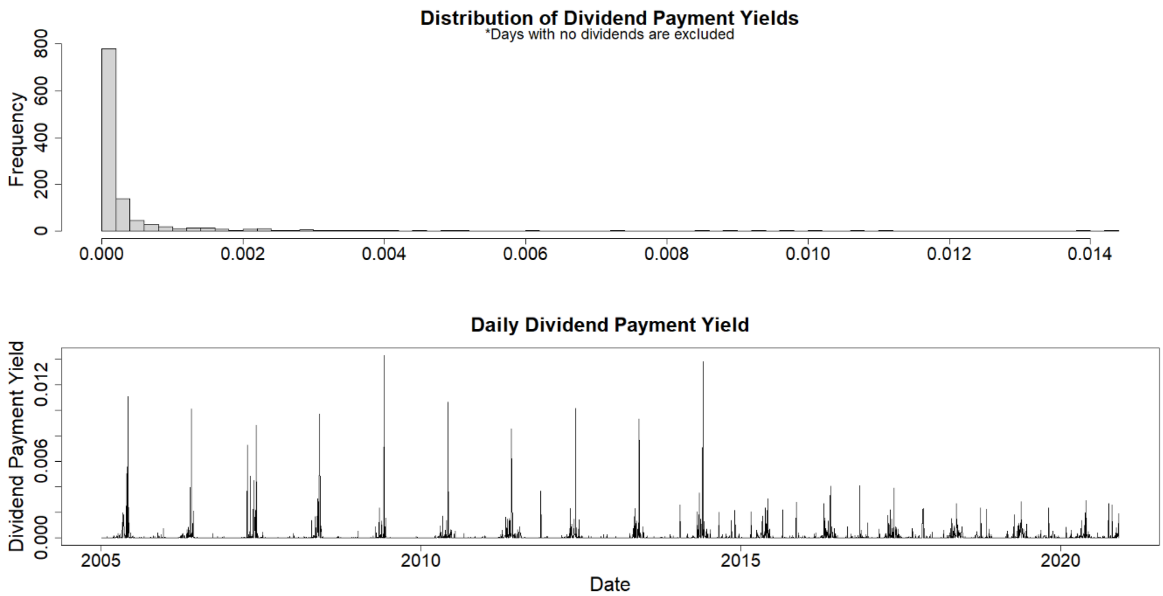

## 5.2.2 Independent Variable: Total Dividend Yield

The main independent variable, that we will analyse as a possible explanation to returns in this thesis, is the aggregated dividend payment yield. Variations of this measure will be used in the analysis and be explained when called upon. In this section though, we will look at the basic variable itself.

The daily dividends are summed for all companies each day and divided by the total market capitalization on the previous day. The distribution of the daily dividend payment yields below reveals that there are a few observations that are much larger than the rest, judging by the long tail to the right. This is because there are a few very large companies, and whenever they pay dividends they are significantly larger than other dividend payments. On days where for instance Equinor pay a dividend, the total dividend yield for that day will be substantially higher. We note that such a distribution in an explanatory variable creates a possible issue with particularly high leverage points in an OLS regression.

**Figure 10 – Distribution and timing of daily aggregated dividend payments**

The **first** figure shows a histogram of daily aggregated dividend payment yields. Days where the dividend yield is zero are excluded from the histogram. As we can see there is a lot of variation in this measure and we observe that some observations are significantly larger than most.
The **second** figure shows the daily aggregated dividend payment yield throughout our time frame. We observe some extreme spikes, corresponding to these very large observations we see in the histogram. These are typically due Equinor, the largest company on the exchange, paying a dividend on that day.
Source: Data from Titlon and Refinitiv

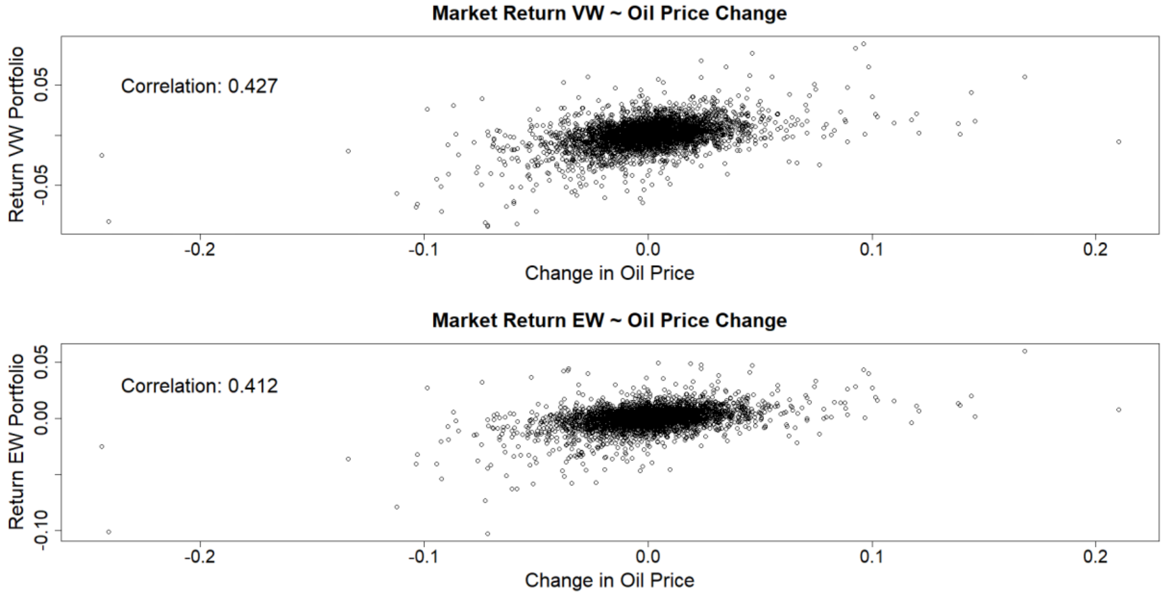



### 5.2.3 Control Variable: Oil Price

As we have touched on, the Oslo Stock Exchange has a particular exposure to oil price changes. The reason for this is obviously the large number of companies within exploration, production and oil services, as well as that many companies have large exposure toward the sector. Equinor, the largest company on the exchange, which we have seen makes up a significant part of the total market capitalization, is also an oil company. Thus, we would expect that returns for the market as a whole are affected by changes in the oil price, with a positive correlation as such. In the plots below, we can see that this is in fact the case, and even the equal weight portfolio, with less weight on Equinor in the calculations, has a positive correlation.

**Figure 11 – Correlation of market portfolios to Oil Price**

The figure shows scatterplots where oil price changes are on the x-axis and the value and equal weighted market portfolio returns are on the y-axis. We see that there is a clear correlation for both portfolios with oil prices. The correlations are 0.427 for the value weighted and 0.412 for the equal weighted portfolios.
Source: Data from Titlon and U.S. Energy Information Administration



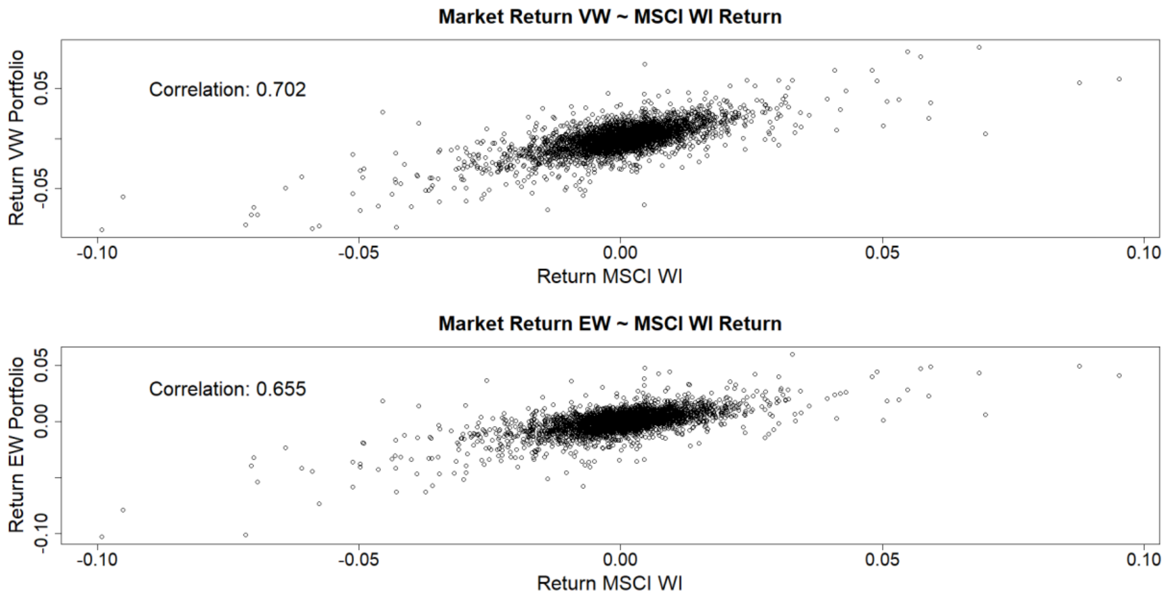

As detailed in the figure, the correlation between oil price changes and market returns is 0.427 for the value weighted portfolio and, perhaps surprisingly, almost the same at 0.412 for the equal weighted portfolio. With such a high correlation for the 16 years of data, we understand that the return on a random day to some extent is affected by oil price changes. As such we assume that the oil price affects the economic outlook of the relevant companies, and thus the market portfolio, and not the other way around (Dahl & Fosby, 2016). Because of this we believe it is a relevant variable to include as a control when attempting to isolate the effect of dividend reinvestments on market returns.

### 5.2.4 Control Variable: MSCI Global Market Index

The Oslo Stock Exchange is as previously discussed a relatively small stock exchange. Thus, we find it appropriate to assume that it is highly susceptible to sentiment and outlook in international markets. Dahl and Fosby (2016) show that this is in fact the case. To account for periods of large volatility or global downturns (or strong markets for that matter) that are likely to drown any possible effects from dividend reinvestments, we want to include an effective control variable for this. As such we include the daily returns from the MSCI World Index. This should control for the variation that can be attributed to market reactions stemming from global market outlook. Below, we can see how our dependent variables correlate with the return of the MSCI World Index.

**Figure 12 – Correlation of market portfolios to MSCI World Index**

The figure shows scatterplots where return on the MSCI World Index is on the x-axes and the value and equal weighted market portfolio returns are on the y-axis. We see that there is a clear correlation for both portfolios with global market returns. The correlations are 0.702 for the value weighted and 0.655 for the equal weighted portfolios.
Source: Data from Titlon and MSCI webpage




## 5.3 Analysis

In this section we will be analysing whether dividend price pressure is present on the Oslo Stock Exchange. We have calculated the returns of the market portfolios and aggregated the total dividend yield for each day. It is the effect from the dividend yield on the market portfolio return that we will be measuring.

The aggregated dividend yield provides a source of potential price pressure that is uncorrelated with business fundamentals. It is well known in advance when the dividends are paid out because dividends are announced and assigned to shareholders some time before the actual payment. Thus the actual payment contains no new fundamental information. The payment is merely a formality in fulfilment of the dividend paying process. When investors receive dividends, they can spend it, leave it in the account or reinvest it. It is common in certain investor groups, for instance with mutual funds, that dividends are reinvested in the market, and as such also broadly (Hartzmark & Solomon, 2019). When dividends are reinvested, cash is flowing to the market and increasing demand for stocks. Thus, if dividend price pressure exists and is significant, we would expect market returns to be boosted on days where this cash is reinvested. If so, dividend reinvestments might help explain some of the deviations from fundamental financial theory that have been observed in the market. Hartzmark and Solomon (2021) show that uninformed price pressure from dividend reinvestement exists in the American markets. The Oslo Stock Exchange, however, is much smaller and with quite a different set of characteristics such as a large presence of governmental ownership, a few companies making up a large proportion of total market capitalisation, high oil-price dependency and fewer days where dividends are observed (mainly due to the size of the market) to name some. As such whether the findings of Hartzmark and Solomon can translate to results in a more specific context is worth analysing.

### 5.3.1 Base Regression

Our first test will examine the direct relationship between the dependent variable of the value and equal weighted market returns against the independent variable, being the dividend payment yield. An important consideration, however, is what day the market return is measured on. Specifically, it is crucial that we measure the return on the days when we would expect cash from dividends to be reinvested, rather than necessarily the dividend payment date. This is because it is the reinvestment of, rather than the cash payment to investors that would theoretically cause price pressure. Investor attentiveness, investment strategy and varying timing in the fulfillment of payments are all examples of factors that can play a role in when dividends are reinvested. As such we run a regression using different lags from the day of the dividend payment in order to account for possible delays in when cash is reinvested. We also run regressions where we instead use the cumulative sum of the last three days' dividend yields. With this, we hypothesise that we can pick up the effect of dividend reinvestments, even if the reinvestment timing differs over the relevant days. Also, if there are multiple days in a row with higher yield, this cumulative measure would cover any boosted effect over a three-day period. We run all regressions with and without control variables for oil-price changes and the return of the MSCI World Index. The controls are both highly significant in all the following analyses, with p-values below 2e-16.

**Table 1 – Market Portfolio ~ Dividend Payment Yield, Base Regression**

This table shows regressions using the value weighted (1-4) and equal weighted (5-8) market portfolios as dependent variable, and the dividend payment yield as the independent variable. The numbered subscripts on the variables indicate the number of days after (the lag) the given payment yield. The variable Dividend.yield.0.2 thus represents the cumulative payment yield from today (0), the day before (1) and two days before (2). Every even numbered column contains controls for oil-price change and the return of the MSCI World Index. The controls are significant for all relevant confidence levels. In parentheses we have included the t-statistics based on heteroskedasticity robust standard errors.

| | Value Weighted Portfolio | | | | Equal Weighted Portfolio | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Dividend.yield.0.2 | | | -0.03 | 0.25** | | | -0.01 | 0.18** |
| | | | (-0.15) | (2.21) | | | (-0.08) | (2.39) |
| Dividend.yield.0 | -0.19 | 0.17 | | | 0.06 | 0.31** | | |
| | (-0.44) | (0.59) | | | (0.30) | (2.00) | | |
| Dividend.yield.1 | 0.02 | 0.01 | | | 0.07 | 0.06 | | |
| | (0.08) | (0.08) | | | (0.36) | (0.46) | | |
| Dividend.yield.2 | 0.09 | 0.57*** | | | -0.16 | 0.17 | | |
| | (0.34) | (3.42) | | | (-0.77) | (1.03) | | |
| Control Oil/MSCI | No | Yes | No | Yes | No | Yes | No | Yes |
| Observations | 3,993 | 3,993 | 3,993 | 3,993 | 3,993 | 3,993 | 3,993 | 3,993 |
| $R^2$ | 0.0001 | 0.52 | 0.0000 | 0.52 | 0.0001 | 0.46 | 0.0000 | 0.46 |

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

In models (1) and (5), we find no significant effect on value or equal weighted market returns from dividend payments at 0, 1 or 2 days before. Similarly, the coefficient for the cumulative dividend payment yield from those three days is also not significant, as observed in models (3) and (7) for the value and equal weighted portfolios respectively. Thus, the estimated coefficients of these predictors cannot statistically be distinguished from zero for the models without controls. Based on this we do not find any evidence of excess market returns from dividend reinvestments.

When including controls for oil price changes and the MSCI index in the even-numbered models, we observe a different pattern. Firstly, we see that all coefficients now have the same positive sign, indicating at least that the effect of increasing dividend yield is positive for the market return. In model (2) and (6), where we separately run each of the three lagged days' dividend yield against the value- and equal weighted portfolios, we see that one of the predictors in each comes up as significant at the 95% confidence level. The day that is significant differs for the two portfolios, where the two-day lagged dividend yield is significant for the value weighted portfolio, and the un-lagged dividend yield (i.e., the dividend yields on the same day as the returns) is significant for the equal weighted portfolio. As such, we cannot say that any one particular day after a dividend payment consistently shows significant effect on the market return. However, in models (4) and (8) we find that the cumulative dividend yield for the relevant days leading up to and including the day on which return is measured, is significant for both the value and equal weighted portfolios at a 95% confidence level. With no consistent results as to which specific day we see a market reaction to dividends being paid out, we remain agnostic as to which day we would expect to see potential evidence of dividend price pressure. Rather, we deem it more appropriate to use the cumulative dividend payment yield, *Dividend.yield.0.2*, in further analyses as this is significant for both the value and equal weighted market portfolios, when controls are included.

With regard to possible price pressure from dividend reinvestments, we thus do find a statistically significant effect when including control variables. From an economic perspective, the effects are not noticeable as there is no evidence without controls. The added explanatory power of the dividends is also negligible. Nonetheless, controlled for oil price movements and the global MSCI index, the results show that a 0.1% increase in the cumulative dividend payment yield predicts 2.5bp (basis points) increased market returns. A one standard deviation[28] (0.0012244 = 0.12244%) increase in the cumulative dividend payment yield predicts 3.06 bp increased returns.

### 5.3.2 Base Regression with Trimmed Data

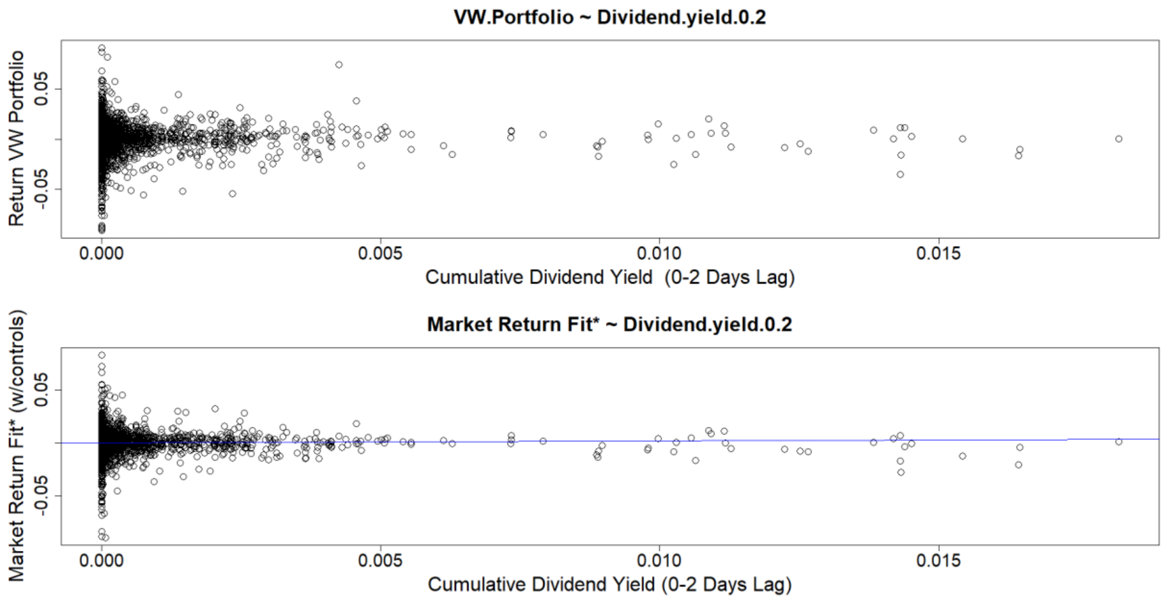
As discussed regarding the distribution of the dividend payment yield, we observed that some of the observations were significantly larger than the rest, typically the days when e.g., Equinor or Telenor pay dividends. In the first plot below, we can see how the cumulative dividend yield, *Dividend.yield.0.2*, the variable we continue with, correlates to the return of the market portfolio, exemplified by the value weighted version. In the second plot we have plotted the fitted values from a regression using only the oil and MSCI index controls to explain the value

[28] We calculate the standard deviation of the dividend payment yield using only those that are non-zero

weighted market return. As such, the plot shows the isolated effect of the *Dividend.yield.0.2* on the fitted values of the market return (controlled for oil and MSCI changes), that we found to be significant in the previous regression (model 4). In both, we see that there are large outliers in the dividend yield (y-axis) from approximately 0.006 and out for instance. These points are potentially strong leverage points on the regression we ran above, meaning that because they are so far out from the rest of the distribution (along the y-axis) they are much heavier weighted when determining the slope of the regression line than a random point in the main cluster. Thus, the returns on those particular days becomes rather important for the overall result.

**Figure 13 – Plot of market return (and fitted return) against the cumulative dividend payment yield**

The **first** figure shows a scatterplot of our main dependent variable, the market return (here the value weighted version), against the main independent variable, the cumulative dividend yield from days 0, 1 and 2 before the return measurement. As we can see, there are some particularly large observations along the y-axis, and these leverage points may have a large influence on base results.
The **second** figure shows the market return, this time the fitted values from regression against oil price changes and MSCI world index returns, and the cumulative dividend payment yield. The blue line is the regression line from our base regression.
Source: Data from Titlon and Refinitv




Statistical methods, such as for instance cooks distance, difference in fits and studentized residuals (Hebbali, 2020), can be used to identify influential observations. However, they typically use an iterative approach where one point at a time is left out and tested. As such it is less likely that it will identify for instance a cluster of deviating points like those observed far to the right in the plots as especially influential (especially considering that their return values (y-axis are rather quite close to the mean as well). Also, one must proceed with caution when looking at effects from influential data points, as the deviations in this case are data points that are just as real as any other. After all, we cannot know whether those larger observations falsely (randomly) contribute to a significant slope in the controlled regression or whether there in fact is an underlying effect (in this case from dividend price pressure) causing this. Nonetheless, we find it relevant to side-step in order to analyse how trimming the most extreme observations of high dividend payment yields would affect the regression coefficients. As mentioned, this must be considered as a sidestep, as data points where the dividend yield is higher should in fact theoretically yield higher returns, and removing them thus makes little sense. We would expect to find that significance is reduced anyhow. We can consider the following as simply testing whether the significant effect found above can also be found among the main cluster of observations where dividend yields are closer to the normal.

With respect to the above, the next test contains analyses where we use the value and equal weighted portfolio returns as dependent variables, and the cumulative dividend payment yield, as above *Dividend.yield.0.2*, as the independent variable. We run the regressions using different subsets of the data where the differences come from the percentage level at which we trim the largest observations in the cumulative dividend payment yield, *Dividend.yield.0.2.* We run regressions using all the data, and where we trim the top 1, 2 and 5% of cumulative dividend yield observations. We include controls for all the regressions. As such, columns (1) and (5) are the same as (4) and (8) from the table above.

**Table 2 – Market Portfolio ~ Dividend Payment Yield.0.2, for various trimming levels**

This table shows regressions using the value weighted (1-4) and equal weighted (5-8) market portfolios as dependent variables, and the cumulative dividend payment yield as the independent variable. The percentage above each model shows the percentage at which we trim away the largest observations in the cumulative dividend payment yield. As such model (1) and (5) are the same as (4) and (8) in Table 1. The numbered subscript .0.2 on the variable means that days 0, 1 & 2 before the given day are used in the cumulative dividend payment calculation. All columns contain controls for oil-price change and the return of the MSCI World Index. The controls are significant for all relevant confidence levels. In parentheses we have included the t-statistics based on heteroskedasticity robust standard errors.

| | Value Weighted Portfolio | | | | Equal Weighted Portfolio | | | |
|---|---|---|---|---|---|---|---|---|
| | All | 1% | 2% | 5% | All | 1% | 2% | 5% |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Dividend.yield.0.2 | 0.25** | 0.59** | 0.23 | 0.41 | 0.18** | 0.33* | 0.25 | 0.61 |
| | (2.21) | (2.14) | (0.81) | (0.79) | (2.39) | (1.78) | (1.14) | (1.41) |
| Control Oil/MSCI | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 3,993 | 3,953 | 3,913 | 3,793 | 3,993 | 3,953 | 3,913 | 3,793 |
| R2 | 0.52 | 0.52 | 0.52 | 0.52 | 0.46 | 0.46 | 0.46 | 0.46 |

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

The results show that trimming the top observations in cumulative dividend yield leads to less significant results. However, at the 1% trimming level (where crucially the absolute largest observations are swiftly removed) the effects are still significant at a 95% and 90% confidence level for the value- and equal weighed portfolios respectively. We see that removing more of the larger observations, when trimming the top 2% and 5%, leads to the effect becoming insignificant. This is however somewhat expected. After all, theoretically, the higher the dividend payment yields are, the higher is the chance of large inflows to the market from dividend reinvestment and thus price pressure. We move on with this in mind but remember that the deviations in the data are not measurement errors and as such cannot really be removed in the way we have done here.

### 5.3.3 Alternative Dividend Standardisation

Moving on we change the approach slightly in order to address another consideration regarding our base regression in Table 1. The dividend yield used in the analysis above, has the market capitalisation as the calculation's denominator, which as we know has some variation. As such we want to verify the approach above by here using an alternative standardisation of the size of the dividends. We create a measure of abnormal dividend payment, where we take the cumulative dividend payment on a given day and divide it by the average cumulative dividend payment of the previous 251 days[29]. The variable is thus a rolling measure of the relative size of the dividend payments compared to the previous year. Using the cumulative payments of the last three days, running from t-2 to t-0, the day of the return measurement, we also here remain agnostic with regard to the timing of dividend reinvestment. We run the regressions with and without control variables for the oil price and MSCI World Index.

**Table 3 – Market Portfolio ~ Abnormal Dividend Payment**

This table shows regressions using the value weighted (1-2) and equal weighted (3-4) market portfolios as dependent variable. The independent variable is the sum of dividends paid 0, 1 and 2 days before (subscript of *.0.2*), divided by the average of the same measure in the period 264 to 13 days before. Every even numbered column contains controls for oil-price change and the return of the MSCI World Index. The controls are significant for all relevant confidence levels. In parentheses we have included the t-statistics based on heteroskedasticity robust standard errors.

| | Value Weighted Portfolio | | Equal Weighted Portfolio | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Abn.div.pay.0.2 | -0.0000 | 0.0001 | -0.0000 | 0.0001* |
| | (-0.47) | (1.64) | (-0.29) | (1.95) |
| Control Oil/MSCI | No | Yes | No | Yes |
| Observations | 3,731 | 3,731 | 3,731 | 3,731 |
| $R^2$ | 0.0001 | 0.53 | 0.0000 | 0.47 |
| *Note:* | | | *p<0.1; **p<0.05; ***p<0.01 | |

Using this alternative normalization, we see in columns (1) and (3) without controls that the coefficients are still not significant at all, and as such only confirms what we found in the base regression. However, for the controlled regressions in columns (2) and (4), where we in the base regression found significant results, the results are very much weakened. Although very close to being significant at the 90% and 95% confidence level for the value and equal weighted portfolios respectively (p-values of ~0.11 and ~0.06), the effect on the value

[29] We use the period from t-264 to t-13 (total of 251) days to calculate the average, as the median days between exdate and paydate is 13, and the median trading days in a year is 251

weighted portfolio turns out insignificant while the effect on the equal weighted portfolio is significant at only the 90% confidence level.

Interpreted in conjunction with the base regression, we find that the effect of dividend price pressure on market portfolio returns is, if any, rather weak. Without controls the effect is none, while with controls we find significant evidence (at 95% confidence) for the base regression, but very weak evidence with the alternative normalization, only significant for the equal weight portfolio at the 90% confidence level. As this analysis' intent is to assess whether dividend price pressure exists on the Oslo Stock Exchange, we deem it appropriate to continue looking for significant effects using the most promising (yet justifiably relevant) variable that we used in the base regression, i.e., the cumulative dividend payment yield. This is because we have established that the effect is at most only significant when including controls and cannot be said to be verified by the regressions using our alternative normalization. Thus, we analyse whether we can find further evidence of the effect and keep at the front of our mind that alternative normalization does not verify the result.

### 5.3.4 Top 5 and Top 30 Dividend Yield Days

In this next analysis we use a slightly different approach where we look specifically at the days within the recent rolling yearly time frame that have yielded the highest potential for large dividend reinvestments. As such we create a dummy variable indicating whether a given day's cumulative dividend payment yield is in the top 5 and/or top 30 of the previous 251 days. As such, this uses a rolling time frame of the last year to find the rank of a given day's cumulative dividend yield. Again, we run all regressions with and without controls for oil and the MSCI World Index, and use heteroskedasticity robust standard errors to calculate the t-statistics

**Table 4 – Market Portfolio ~ Top 5/30 Cumulative Dividend Payment Yield**

This table shows regressions using the value weighted (1-4) and equal weighted (5-8) market portfolios as dependent variable. The independent variables are dummy variables that take on the value 1 if the three day (0, 1 and 2 days before) cumulative dividend payment yield is in the top 5 (30) of the last 251 trading days. Every even numbered column contains controls for oil-price change and the return of the MSCI World Index. The controls are significant for all relevant confidence levels. In parentheses we have included the t-statistics based on heteroskedasticity robust standard errors.

| | Value Weighted Portfolio | | | | Equal Weighted Portfolio | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Top5.Div.yield1 | 0.0002 | 0.002** | | | 0.0002 | 0.002** | | |
| | (0.12) | (2.11) | | | (0.15) | (2.14) | | |
| Top30.Div.yield1 | | | 0.0004 | 0.001* | | | 0.0002 | 0.0005 |
| | | | (0.63) | (1.69) | | | (0.52) | (1.39) |
| Control Oil/MSCI | No | Yes | No | Yes | No | Yes | No | Yes |
| Observations | 3,993 | 3,993 | 3,993 | 3,993 | 3,993 | 3,993 | 3,993 | 3,993 |
| $R^2$ | 0.0000 | 0.52 | 0.0001 | 0.52 | 0.0000 | 0.46 | 0.0001 | 0.46 |

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

From the regressions we observe that all coefficients, both with and without controls, are positive for the top 5 and top 30 observations for both market portfolios. For the odd-numbered models though, run without the control variables, we observe that none of the coefficients are significant. Again, this reflects our previous conclusions that any possible underlying effect cannot be seen by the naked eye of an investor. Using control variables in the even numbered models, we find that the results generally well reflect what is previously found. For the top 30 days, we find only very weak effects, insignificant for the equal weight portfolio, and only significant at a 90% confidence level for the value weighted portfolio. For the top 5 days however, we find that the effect on market return is consistently significant at a 95% confidence level. This indicates that, controlled for oil price changes and return of the MSCI index, the top 5 largest dividend yield paying days contribute significantly to returns, and as such provides evidence that some effect of dividend price pressure exists. The magnitude is once again small though. For a day that is in the top 5 of the previous year, the model predicts that the value weighted market returns are increased by 0.2%, or more precisely (removing rounding) 24.6 bp, when controlled for oil prices and the MSCI Index.

The results also seem to be in line with the trend we find regarding the impact of the larger dividend yield paying days from the regressions run on the trimmed datasets in Table 2. Essentially, we find that (adjusted for our control variables) the effect of dividend price pressure becomes significant when looking at the largest dividend payments.

### 5.3.5 Addressing State Ownership In Our Analyses

In our final analysis we seek to investigate the impact of government ownership, or rather what happens when it is removed. As such, this tackles a very characteristic trait of the Oslo Stock Exchange. A critical assumption in the theoretical framework of dividend price pressure, is that dividends are in fact reinvested. This makes the analysis of the impact of government ownership highly relevant and somewhat unique to the Oslo Stock Exchange. This is because all dividends that the government receives from its investments are not reinvested, but instead assigned to the state budget, and thus spent by the government. As such, with the government owning a relatively large proportion of the total market, it means that only the dividends left after the government has taken its share, are actually relevant to the assumptions of reinvestment. Below we see that the government owns a significant share of the market and for each year has received a substantial percentage of the total dividend payments.

**Figure 14 – Development in State ownership on the Oslo Stock Exchange**

The figure shows the fraction of the total market capitalization owned by the Norwegian state throughout the time frame. They own a substantial fraction, possibly reducing the effect from reinvested dividends on market returns.
Source: Data from Titlon and the States Ownership Reports

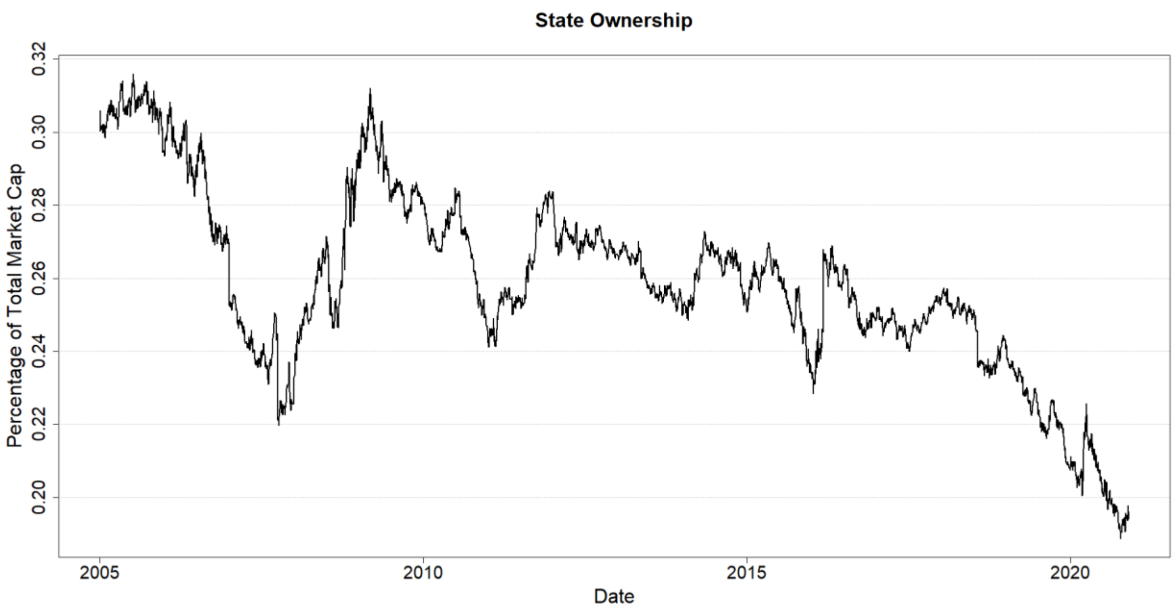
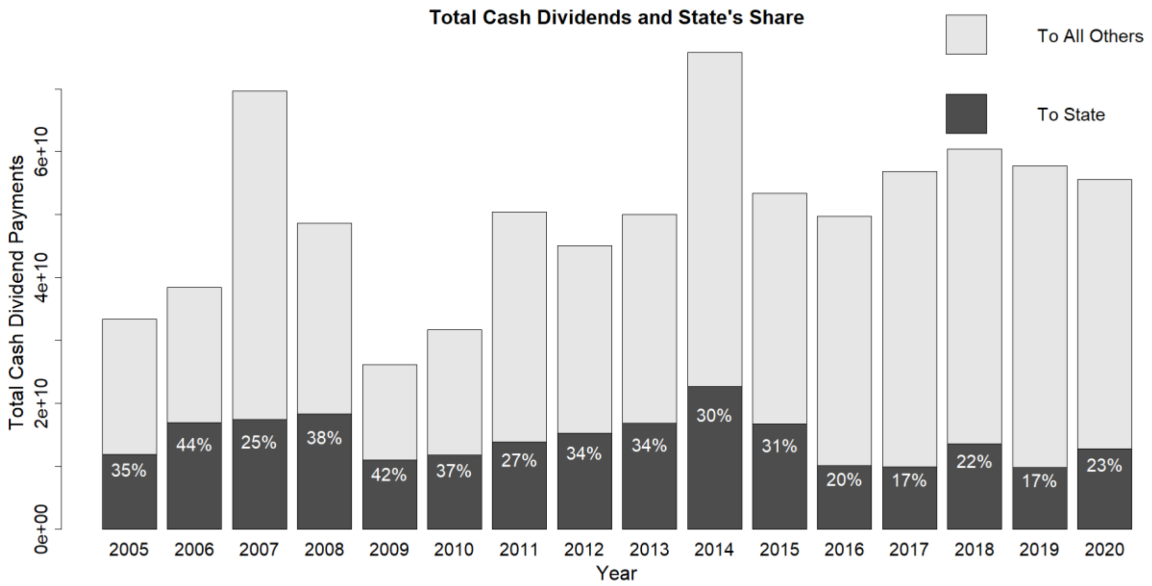


**Figure 15 – The total cash dividends for each year and the fraction to the Norwegian State**

The figure shows the fraction of the total dividends that goes to the state each year throughout the time frame. As the state owns a substantial fraction of the market and do not reinvest, only the dividends paid to all other investors is subject to the assumptions of dividend reinvestment
Source: Data from Titlon, Refinitiv and the States Ownership Reports




We analyse how the governments ownership impacts our base regressions by creating a new adjusted dataset and running the base regressions with the adjusted data. Thus, we use both the value and equal weighted market portfolios as the dependent variables, and the cumulative dividend yield, *Dividend.yield.0.2*, as our main independent variable. We adjust for the ownership of the government in two critical ways based on data from the state's ownership reports (Nærings- og Fiskeridepartementet, 2021). The first is that we remove the share of any dividend payment that is equivalent to the government's ownership share in that company. As such we are only left with the dividend payments that are subject to the assumptions regarding reinvestment, and this reduces the size of the dividends on any day where a government owned company is involved. Second, we also remove from the market capitalization of each company the share that is owned by the government. This means that we reduce the weight of government owned companies in the value weighted market portfolio (the equal weight portfolio keeps the same weights as before). The second point may seem slightly odd, the market capitalization of a company does not change based on who owns it. However, we argue that when looking at dividend price pressure, and adjusting for government ownership, it is the investment universe for all investors (other than the government) that is relevant. We can imagine the case where the Oslo Stock Exchange consists of only two investors. One is the government, and the other is the sum of all other investors. This one investor would then only be able to buy the companies and shares that the government does not own. Hence, his portfolio would consist of the entire market, but with reduced weights (compared to the total market) in those companies that the government owns.

**Table 5 – Market Portfolio ~ Cumulative Dividend Yield (0-2), Without Government Owned Companies**

This table shows regressions using the value weighted (1-2) and equal weighted (3-4) market portfolios as dependent variable. The independent variable is the cumulative dividend payment yield from 0, 1 and 2 days before. This regression is based on data where government ownership is removed from the data by (1) removing the proportion of dividend payments that go to the government, and (2) adjusting the market capitalization of the relevant companies by removing the value of the government's shares. As such, the value weights in the market portfolio for government owned companies will be smaller than for the total market. Every even numbered column contains controls for oil-price change and the return of the MSCI World Index. The controls are significant for all relevant confidence levels. In parentheses we have included the t-statistics based on heteroskedasticity robust standard errors.

| | Value Weighted Portfolio | | Equal Weighted Portfolio | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Dividend.yield.0.2 | 0.13 | $0.40^{***}$ | 0.08 | $0.26^{**}$ |
| | (0.62) | (2.64) | (0.57) | (2.42) |
| Control Oil/MSCI | No | Yes | No | Yes |
| Observations | 3,993 | 3,993 | 3,993 | 3,993 |
| $R^2$ | 0.0001 | 0.53 | 0.0001 | 0.46 |
| *Note:* | | | | *p<0.1; **p<0.05; ***p<0.01 |

The results from this table are comparable to those in the columns (3), (4), (7) and (8) in our base regression in Table 1 respectively. The difference here being our adjustments for government ownership in the data. The coefficient for the cumulative dividend yield is now positive for all the models, as opposed to what was the case in Table 1. However, the models without controls are still insignificant, as has been the case throughout all the analyses. For the models with control variables included, the significance of the coefficients have increased for both the value- (t-statistic from 2.21 to 2.64) and equal (t-statistic from 2.39 to 2.42) weighted portfolios. With p-values of 0.008 and 0.016 the results are now significant at a 99% and 95% confidence level. This indicates that when removing the governments share of dividends and market value, the significance of the effect of dividend price pressure increases. We also see that the increase in significance as such, is larger for the value weighted portfolio. This makes sense as the value weighted market portfolio is more affected by removing government ownership than is the equal weight portfolio. Finally, we note that the explanatory power in model (3) for the value weighted market portfolio with control variables actually increases by 0.01 compared to the comparable model without the adjustments for government ownership.

With regard to the regression above, we note that interpretation of the variables in the specific models are the same as ever. However, with any interpretation with respect to how government ownership actually effects the results, we need to tread cautiously. This is because the above regression does not quantify the actual effect of government ownership on the results. We only compare similar results, knowing that we have adjusted the underlying data for government ownership. Whether the slightly increased significance is because of removing the government shares of dividends and market value or simply that the adjusted data happens to coincide with the patterns mentioned above, we cannot tell. As such we include one last regression where we handle this issue in an overarching way.

For our final regressions we thus move back to the unadjusted dataset. We use the value and equal weighted market portfolios as the dependent variables and the abnormal cumulative dividend payment as our main independent variable. Thus, we revisit our alternative normalization from Table 3. However, we also include a dummy variable, *Gov.dummy*, indicating whether the abnormal cumulative dividend measure on a given day contains dividends from a company which is government owned. If it does, the dummy takes on the value of 1. Similarly, we also run regressions using a different second variable, where *Gov.pct* represents the fraction of the dividends that make up abnormal cumulative dividend measure that belong to the government. We use the abnormal dividend measure instead of dividend yield because we want the dividend measure to be free of any effects from the market capitalization (which is included in denominator of the dividend yield), of which the government after all owns a substantial fraction. The abnormal dividend payment uses the actual total cash paid on any given day and compares it to the rolling year average. As such, if government ownership leads to weaker returns because of reduced effect from dividend price pressure on days where a government owned company contributes to the dividend measure, we expect the coefficient of each of the government control variables to be negative. Furthermore, we point out that the equal weighted portfolio is perhaps more relevant in this context because the value weighted portfolio is heavily influenced by government owned companies.

**Table 6 – Market Portfolio ~ Cumulative Abnormal Dividend (0-2) + Gov.Dummy/Gov.pct**

This table shows regressions using the value weighted (1-2) and equal weighted (3-4) market portfolios as dependent variable. The independent variable is the abnormal cumulative dividend payment from 0, 1 and 2 days before. The *Gov.dummy* variable is a dummy variable that takes on the value 1 if a government owned company contributes to the dividends measured in the *Abn.div.pay.0.2* variable. The *Gov.pct* variable represents the fraction of the dividends measured in the *Abn.div.pay.0.2* variable that belongs to the government. Every even numbered column contains controls for oil-price change and the return of the MSCI World Index. In parentheses we have included the t-statistics based on heteroskedasticity robust standard errors.

| | Value Weighted Portfolio | | | | Equal Weighted Portfolio | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Abn.div.pay.0.2 | -0.0000 | 0.0001* | 0.0000 | 0.0001* | -0.0000 | 0.0001** | 0.0000 | 0.0001* |
| | (-0.42) | (1.66) | (0.03) | (1.87) | (-0.05) | (2.10) | (0.19) | (1.95) |
| Gov.dummy | -0.0000 | -0.0001 | | | -0.0002 | -0.0003 | | |
| | (-0.03) | (-0.20) | | | (-0.32) | (-0.59) | | |
| Gov.pct | | | -0.002 | -0.001 | | | -0.001 | -0.001 |
| | | | (-0.74) | (-0.68) | | | (-0.60) | (-0.56) |
| Control Oil/MSCI | No | Yes | No | Yes | No | Yes | No | Yes |
| Observations | 3,731 | 3,731 | 3,731 | 3,731 | 3,731 | 3,731 | 3,731 | 3,731 |
| $R^2$ | 0.0001 | 0.53 | 0.0002 | 0.53 | 0.0000 | 0.47 | 0.0001 | 0.47 |

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

From the regression results we observe that in fact all of the government related variables have a negative sign. The interpretation of this in isolation is that whenever the government is involved at the receiving end of a dividend payment, it reduces the return. However, coefficients are all insignificant, meaning that the effect cannot be statistically distinguished from zero. The fact that all results turn out negative is at least consistent, although we cannot conclude whether government ownership reduces the effect of dividend price pressure through not reinvesting. The results seen throughout this section in Table 5 and 6, does at least consistently, though insignificantly, tilt toward a negative effect on returns from government ownership.

# 6. Conclusion

In this thesis we have examined the possible existence of dividend price pressure on the Oslo Stock Exchange. From Xavier Gabaix and Ralph Koijen's (2021) paper on the theory of inelastic markets, it is suggested that a supply and demand interpretation of financial markets can provide new insights regarding price fluctuations. Hartzmark and Solomon (2021) use this to study a specific exogenous shock to stock demand. They argue that reinvestment of dividend payments represents an uninformed cash inflow to the market. Their argument is based on the assumption that institutional investors, and especially mutual funds, invest passively into a broad portfolio. They further assume that these investors reinvest the dividend received shortly after distribution. For days on which, or immediately after, a dividend is distributed, they find that reinvestments cause upward price pressure.

## 6.1 Conclusion

Oslo Stock Exchange has characteristics that distinguishes it from larger markets, such as the US markets which Gabaix and Koijen, and Hartzmark and Solomon study. Three characteristics standout in particular: 1) Oslo Stock Exchange is small in terms of number of companies and total market capitalisation, 2) The Norwegian state controls a considerable share of the total market capitalisation, and 3) Due to a large oil and gas sector, compared to other industries, the market portfolio has a relatively strong positive correlation with oil prices. These factors likely affect the price pressure from dividend reinvestments. Quantitatively, we assess the existence of price pressure from dividend reinvestments on Oslo Stock Exchange by running regressions on market returns and using various standardised measures of daily aggregate dividend payments as the explanatory variable. We mainly use a cumulative measure of the aggregate dividend payments from the same and the two preceding days of the return measurement. We run all regressions with and without controls for changes in oil price and the return of the MSCI World Index. As such, we hypothesize that oil price in conjunction with global market returns explains some of the variation on the Oslo Stock Exchange.

Our base regression shows that the dividend payment yield has significant effect on both our value weighted and equal weighted portfolio when using controls. This indicates that reinvestment of dividends exerts significant influence on returns that are controlled for variations from changes in oil prices and global returns. Without controls, there is no significant effect from dividend payments on market return. Using our alternative standardisation of aggregate dividend payments, where we compare each observation to the last year's average, we find that the effect is not significant for the value weighted portfolio, and only weakly significant for the equal weighted portfolio, with controls. As such, by changing how we standardise the dividend payments in the independent variable the results become substantially less significant, indicating that the effect of dividend price pressure found in the base regression is not particularly robust to changes in measurement method. Nonetheless, we run a slightly different approach using a new main independent variable. We construct dummy variables that check if the dividend yield on a given day is among the top 5 and/or 30 highest observations in the last 251 trading days. The results from this show that the market return on days in the top 5 observations of dividend yield are significantly higher than other days when controlled for oil price changes and global market return. As for days in the top 30 of dividend yield observations, the effect on returns is insignificant. As such, it seems that the effect of any price pressure from dividend reinvestment only materializes when dividends become sufficiently large. Again, when excluding control variables, we find no significant effects at all.

In the last part we address the substantial state ownership on Oslo Stock Exchange with regard to dividend price pressure. This is relevant because the state does not reinvest dividends, and as such, days where large state-owned companies pay dividends pollute the reinvestment rate and thus potentially the effect of dividend price pressure. We do this by 1) Running our base regression using data where the state's ownership shares are removed, and 2) Running the base regression and including variables controlling for state ownership. Although we do not find statistical evidence of state ownership reducing the effects of dividend price pressure, the data carries slight but consistent indications that it might be the case.

The statistical results indicate that when controlling for changes in oil price and the global market index, increased aggregate dividend payments have a significant effect on daily market returns for most of our tests. However, subject to changes in the method of measurement standardization, and that results are mainly significant for the relatively large observations of dividend payments, the evidence seems less convincing. When removing control variables none of the tests show any evidence of dividend price pressure.

While we document the statistical results, we have not yet considered the economic implications. Considering that we find no evidence without control variables, and unsteady evidence with, it comes as no surprise that the economic significance of the studied effects is highly limited. The economic magnitudes of the results are miniscule, and for an investor on the Oslo Stock Exchange, next to completely irrelevant.

## 6.2 Limitations and Further Research

This thesis has covered the topic of dividend price pressure on the Oslo Stock Exchange in the context of the recently proposed markets interpretations of Gabaix and Koijen (2021). Further, the thesis is inspired by the work of Hartzmark and Solomon (2021). There are certain limitations to our analysis that we acknowledge and suggest are relevant for further research.

Perhaps the biggest limitation to our analysis is the difficulty in finding good data on size, behaviour and strategies of various investor groups on the Oslo Stock Exchange. For instance, our research relies on assumptions regarding dividend reinvestments and the timing as such, the degree of activeness in stock picking, and how broadly they invest in terms of country, exchanges and companies. Further research into these topics might open opportunities to discover why the results we find are different from those Hartzmark and Solomon (2021) find on the American exchanges. Although out of scope for this thesis, these topics are also highly relevant for studies about inelasticity on the Oslo Stock Exchange, as studied by Gabaix and Koijen in 2021. The assumptions they lay in their interpretation of financial markets is an exciting starting point for multiple, possibly groundbreaking studies.

An aspect of particular interest for Norwegian market participants is the impact that state ownership has on the assumptions laid out in this thesis. For instance, one might analyse whether or not the stocks of state-owned companies exhibit less elasticity in the supply and demand model of the market. If so, this might warrant a discussion of whether the state should reconsider their positions in these companies. Apart from our knowledge that the state does not reinvest dividends, with it being such a large owner, there are likely aspects of their ownership that we have not considered, and yet might affect our thesis.

The scope of this thesis is limited to studying the daily market returns, and the effect from dividend price pressure on this. As such, we do not consider any longer-term effects of dividend price pressure. Further studies might investigate whether dividend reinvestments lead to any sustained effects on market return. Furthermore the scope of our analysis could be expanded on in a multitude of ways, including but not limited to the inclusion of other control variables, expanded time frame, new data sources and different methodologies for the analysis.

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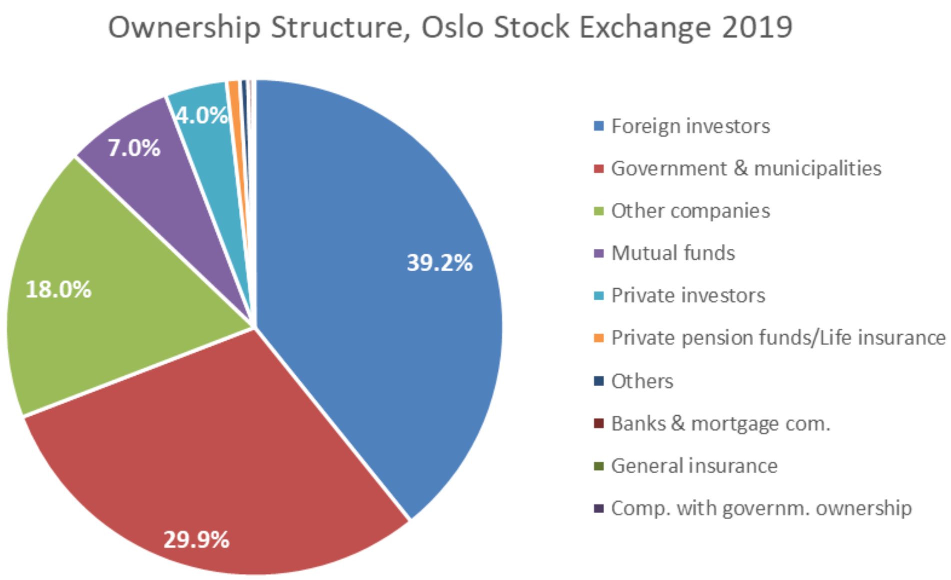
# 7. Appendix

### 7.1.1 Appendix A – Ownership Structure, OSE 2019

**Figure 16 – 2019 Ownership structure on the Oslo Stock Exchange**

The figure shows the proportions that each investor group owns in the Oslo Stock Exchange. Mutual funds make up 7%, but is likely a subcategory to the foreign investors category as well.
Source: Oslo Børs




### 7.1.2 Appendix B – State Ownership of Companies in Data

**Figure 17 – Companies owned by the State in 2020 (and companies previously owned)**

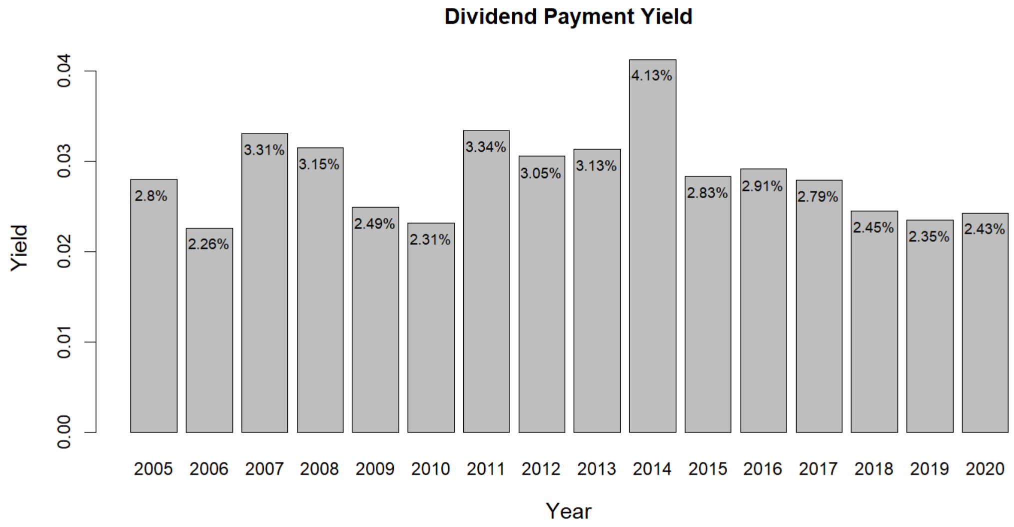
The table shows the ownership share of the state in companies on the Oslo Stock Exchange as of 2020. Cermaq, Entra and SAS are previously owned companies that are included in the data.
Source: State Ownership Report 2020

| Company (As in data) | State Ownership in 2020 |
|---|---|
| **Equinor** | 67% |
| **Telenor** | 54% |
| **Kongsberg Gruppen** | 50% |
| **Yara International** | 36% |
| **Norsk Hydro** | 34% |
| **DNB** | 34% |
| **Aker Solutions** *Bought in 2020* | 12% |
| **Akastor** *Bought in 2020* | 12% |
| **Cermaq** *Held until 2013* | |
| **Entra** *Held between 2014 and 2019* | |
| **SAS AB** *Held until 2017* | |

## 7.1.3 Appendix C – Dividend Payment Yield on Oslo Stock Exchange

**Figure 18 – Oslo Stock Exchange aggregated yearly dividend payment yield**

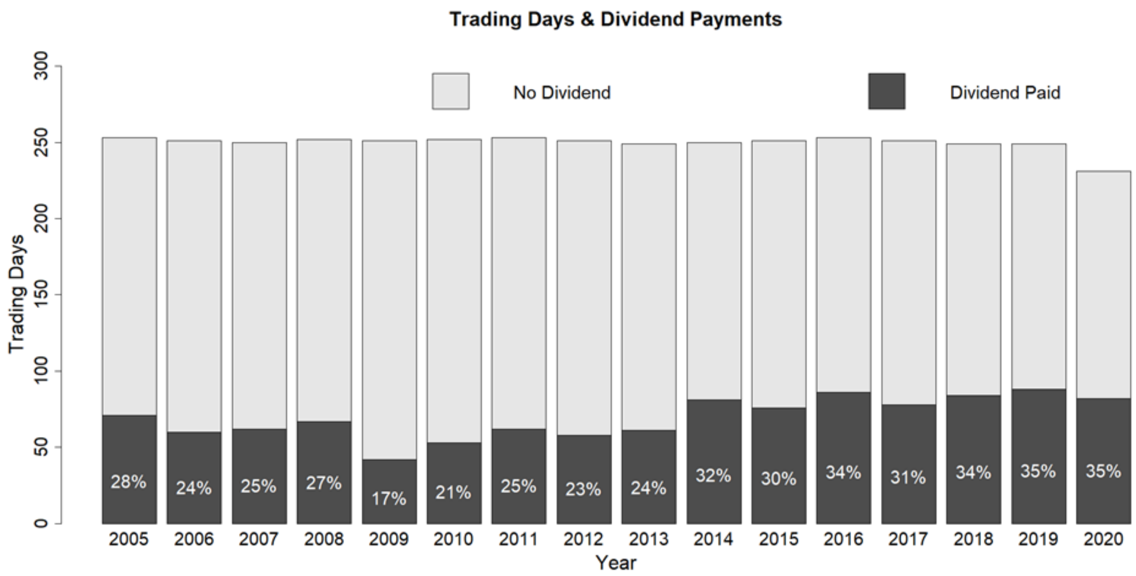
This figure shows the aggregated dividend payment yield for each year throughout the time frame.
Source: Titlon & Refinitiv Data




## 7.1.4 Appendix D – Trading Days & Dividend Payment Days

**Figure 19 – Oslo Stock Exchange number of trading days and fraction that contains dividends**

The figure shows the number of trading days each year, and the fraction of these days where a dividend is paid out.
Source: Titlon & Refinitiv Data



### 7.1.5 Appendix F – Return Volatility of Market and MSCI Index

**Figure 20 – Return volatility in studied time frame for VW and EW portfolio, and MSCI World Index**

The figures show how the volatility of market portfolios varies throughout the time frame. We see that the MSCI index shows the same patterns, and as such, we consider that our market portfolios likely are affected by volatility in global markets
Source: Titlon and MSCI webpage