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Master Thesis

Determinants of Cash Holdings and the Effect of the 2008 Financial Crisis: An Empirical Investigation of Norwegian Listed Firms

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Determinants of Cash Holdings and the Effect of the 2008 Financial Crisis: An Empirical Investigation of Norwegian Listed Firms

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Abstract

In this paper we examine which determinants affect the cash holdings for Norwegian firms listed on Oslo Stock Exchange between 2001 and 2018, and if the effect of the determinants changed during the 2008 financial crisis. To analyze the effect of the 2008 financial crisis, we divide our sample into four sub-periods: Base period (2001-2003); Pre-crisis period (2004-2006); Crisis period (2007-2009); Post-crisis period (2010-2018). The results show that the determinants leverage, size, and capital expenditure have a significant negative effect on cash holdings in all periods, indicating that the 2008 financial crisis did not affect these determinants. However, we find that there are four determinants that were affected by the 2008 financial crisis. Operating cash flow turned insignificant during the crisis, from a significant positive effect before the crisis and to a significant negative effect after the crisis. NWC had a significant negative effect on cash holdings in the Base- and Post-crisis period, while insignificant in the Pre-crisis- and Crisis period. ROA is only significant in the Crisis period with a positive effect on cash holdings, while Tobin's Q had a significant positive effect on cash holdings for all periods except the Pre-crisis period. Additionally, dividend yield has no significant effect on cash holdings for Norwegian listed firms.

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1. Introduction

How much cash a company should hold and which determinants affect the cash holdings is an everlasting question which researchers have studied for decades, and it is recognized amongst all businesses. The importance of cash holdings is also strengthened by the fact that the amount of cash a company should hold is affected by the law, which dictates that companies at all times shall have equity and liquidity that is justifiable based on the risk and scope of the companies activities (Allmennaksjeloven, 1997). Cash holdings more than doubled between the period 1980 to 2006, from 10.5% to 23.2% in U.S. firms, indicating that the appropriate amount of cash holdings change over time (Bates et al., 2009). Cash holdings result from a firm's process of managing cash and short-term investment to ensure the company's solvency (Ahmad et al., 2018). There are both costs and benefits of holding cash, whereas holding too much cash increases the alternative cost of other profitable investments, and holding too little cash increases the risk of liquidating assets on short term notice. This indicates the importance of the topic of cash holdings in companies capital structure.

The research on corporate cash holdings tends to be examining the U.S. market or other major markets, which indicates a knowledge gap on the theories and determinants of cash holdings in smaller markets. Further, the study of Demirgüç-Kunt and Maksimovic (1996) and La Porta et al. (1999) states that different markets and countries tend to fluctuate, indicating the importance of researching different countries. To our knowledge, there is no research on cash holdings and which determinants are essential for companies in the Norwegian market. Therefore, we find it interesting to study the change in cash holdings and the determinants for Norwegian listed firms. Additionally, there is minor research on how companies change their cash holding and how the effect of known determinants on cash holdings change during major business altering events, such as the 2008 financial crisis. Further, one could also argue that there are few times markets are more imperfect than during major altering events. Therefore, it is of interest to study if the 2008 financial crisis affected determinants. Hence, the purpose of the paper is to identify the determinants of cash holdings for Norwegian firms listed on Oslo Stock Exchange (OSE) and how they are affected by the 2008 financial crisis.

"What determines the corporate cash holdings in Norwegian listed firms before, during and after the 2008 financial crisis?"

The objective of the paper is two-folded. Firstly, we want to examine which determinants are applicable and significant for cash holdings in Norwegian listed firms in the time period 2001 to 2018. We examine the internal variables, operating cash flow, leverage, net working capital (NWC), return on assets (ROA), size, Tobin's Q, dividend yield and capital expenditures. The latter is to analyze if the significance or direction of the determinants change due to the 2008 financial crisis. The paper provides evidence that the determinants' leverage, size, and capital expenditure have a significant negative effect on cash holdings and that the 2008 financial crisis did not affect these determinants. However, there is evidence that the 2008 financial crisis affected the determinants operating cash flow, NWC, ROA, and Tobin's Q in line with both significance and the direction of effect on cash holdings. Additionally, we find no evidence that dividend yield affects cash holdings for Norwegian listed firms.

Nadiri (1969) finds that cash holdings fluctuate but with a target cash level when studying U.S. manufacturing firms. The fluctuation of cash holdings is further supported by Dittmar et al. (2003), who find a large increase in cash holdings and conclude considerable differences between countries and companies within countries. Bates et al. (2009) find that the cash holdings in the U.S. doubled from 1980 to 2006 from 10.5% to 23.2%. The study of Opler et al. (1999) conducted in the U.S. from 1971-1994 find that firms tend to hold more cash as the benefit of excess liquidity is higher than the cost of liquidity shortage. Small- and growth firms tend to have higher cash holdings, while the large firms with great access to the capital markets tend to have lower cash holdings. Furthermore, studies indicate that there are several determinants and firm characteristics that determine cash holdings, such as firm size, profitability, growth opportunity and asset tangibility, leverage, dividends and investment activity (Al-Amarneh, 2015; Ferreira & Vilela, 2004; Gill & Shah, 2012; Nguyen, 2006; Opler et al., 1999; Saddour, 2006).

Although there is a great amount of research on the determinants that affect cash holdings, there is considerably less research on how major altering events, such as

the 2008 financial crisis, affect cash holdings and the determinants. Campello et al. (2011) studied 800 firms from North America, Asia and Europe, and the effect of the 2008 financial crisis on internal and external capital. The study indicates less access to external capital and that the companies have to some extent, to choose whether they want to save or invest the internal capital. Further, the study indicates that holding excess cash eased the impact of the 2008 financial crisis. The study of Pinkowitz et al. (2013) of cash holdings of U.S. companies compared to foreign companies, find an increase in cash holdings during the 2008 financial crisis for both markets. These results are supported by an empirical study of Al-Amarneh (2015). The results of the study conclude that companies tend to have higher cash holdings during and after the crisis than under normal circumstances.

There are several theories on capital structure. Arguably, the most recognized theory about capital structure and cash holdings, in general, is the theory of Modigliani and Miller (1958) of a perfect market. This theory suggests that there is no need for excess cash in a perfect market. However, there are two rival theories of an imperfect market, which stand out in terms of recognition and importance as explanatory factors for firms cash holdings, which is the tradeoff theory and the pecking order theory (Ben Amor, 2012; Fama & French, 2002; Serrasqueiro & Caetano, 2015). Typical for these theories is the agreement that capital structure and cash holdings are determined as a balance of different factors.

The tradeoff theory proposes that a company recognizes an optimal capital structure of debt and equity, thus the cash holdings, by looking at costs and benefits of holding cash and debt financing (Myers, 1977). The benefit of holding debt is the tax deduction due to interest on debt, the cost of increased debt is the increased distress cost, opportunity costs and agency costs. The marginal benefit of debt is decreasing, while the marginal risk of debt is increasing. Thus, there is an optimal tradeoff, where companies maximize the value.

Opposing the tradeoff theory, the pecking order theory suggests that there is no optimal cash level for the companies. Further, the pecking order theory divides financing into three methods: internal financing, debt, and new equity (Myers & Majluf, 1984). The theory suggests that there is a pecking order of which financing

method a company should use. The preferred method is using internal financing, with cash from retained earnings ranked as the primary source of financing. When internal financing is unavailable, external financing is needed, with debt as the preferred, before issuing equity as the least preferred. The reason for the pecking order is to choose the financing method where there is the least asymmetric information (Myers & Majluf, 1984). With managers possessing more information about the firm than investors, investors might assume that issuing shares could indicate that the company is overvalued, thus undervaluing and underbidding the new shares. On the other hand, issuing debt could indicate that managers are confident in the company. Hence the investors will think the investment is profitable. As an exception to the rule, issuing equity for technology or growth companies could indicate profitable investments instead of an overvaluation of a company. The pecking order theory does not have a target cash level but significant cash as a buffer between the investment decisions and retained earnings. The managers plan companies' dividend policy to investment decisions to use retained earnings as the favourable financing method.

The literature indicates that the tradeoff theory and the pecking order theory tend to apply to different companies and markets based on different firm characteristics (Serrasqueiro & Caetano, 2015). The most mentioned characteristics are those that concern large and small companies and factors that often depend on this, such as profitability and growth opportunities. Smaller firms tend to be less profitable but with a higher growth rate than larger firms that are more profitable but have a lower growth rate. Less profitable firms will not be able to utilize the benefits of the tax shield from debt to the same degree as more profitable firms. At the same time, smaller firms tend to have a higher degree of information asymmetry compared to larger firms. Hence the literature indicates that smaller firms tend to be supported by the pecking order theory, while larger firms tend to be supported by the tradeoff theory (Gill & Shah, 2012; Serrasqueiro & Caetano, 2015).

Consequently, this paper aims to increase the knowledge and contribute to discussing how and why Norwegian listed firms change their cash holdings. Further, this will better equip policymakers, companies, and financial institutions to predict how the Norwegian market is affected and changing through a financial

crisis and which determinants influence the cash holdings. Thus, the results will strengthen the literature on determinants affecting cash holdings.

Further, the paper consists of the following sections: Section (2) consists of hypothesis development. Section (3) will present data and descriptive statistics. In Section (4), the methodology for this paper is elaborated. Section (5) will present the results of the analysis. In section (6), we will discuss the results presented in section (5). Lastly, section (7) will offer a conclusion.

2. Hypotheses development

Earlier studies suggest that operating cash flow has a significant effect on cash holdings. Opler et al. (1999), Dittmar et al. (2003), Ferreira and Vilela (2004), Saddour (2006) and Gill and Shah (2012) find evidence that operating cash flow has a significant positive effect on cash holdings. Also, Bates et al. (2009), all things being equal, concludes that companies with higher operating cash flow have higher cash holdings. Opposing this, Kim et al. (1998) state a negative relationship between operating cash flow and cash holdings. Further, the study of Al-Amarneh (2015) finds both a positive and negative relationship of operating cash flow on cash holdings. The pecking order theory suggests that companies prefer to finance through internal financing such as retained earnings instead of external financing. The pecking order theory predicts a positive effect between operating cash flow and cash holdings. The tradeoff theory suggests that companies with high operating cash flow can finance their activities through cash flow instead of cash holdings and thus reduce the cash holdings when cash flow is insufficient. The tradeoff theory predicts a negative effect between cash flow and cash holdings.

H1: *"The operating cash flow has a significant effect on cash holdings of similar directions throughout the periods"*

According to Opler et al. (1999), Ferreira and Vilela (2004) and Al-Najjar (2013), there is a negative relationship between leverage and cash holdings. In contrast, Gill and Shah (2012) find a positive relationship between leverage and cash holdings. Al-Amarneh (2015) finds both a significant positive and negative relationship of leverage on cash holdings. Companies choose internal financing before external

financings, such as debt, in line with the pecking order theory. Therefore, the pecking order theory predicts that leverage has a negative effect on cash holding. The tradeoff theory firstly predicts more leverage to extract the tax benefit and thus lower cash holdings. On the other hand, the tradeoff theory also acknowledges that higher leverage increases distress cost, thus higher cash holdings. Therefore, the tradeoff theory predicts both a positive and negative effect of leverage on cash holdings.

H2: *"Leverage has a significant effect on cash holdings of similar directions throughout the periods"*

Literature shows findings of a significant negative effect of NWC on cash holdings (Al-Amarneh, 2015; Bates et al., 2009; Dittmar et al., 2003; Ferreira & Vilela, 2004; Opler et al., 1999). The literature argues that the reason is that NWC is a substitute for cash holdings, which can be converted at a low cost into cash when necessary. The argument that the companies can convert NWC to cash when needed is also applicable for the tradeoff theory. The companies can choose to invest the excess cash in profitable projects, consistent with the tradeoff theory. Therefore, the tradeoff theory predicts a negative effect of NWC on cash holdings.

H3: *"NWC has a significant effect on cash holdings of similar directions throughout the periods"*

Opler et al. (1999), Ozkan and Ozkan (2004) indicate that ROA negatively affects cash holdings. This is due to a lower need for cash because they can finance transactions and investments with ROA instead of cash, similar to operating cash flow. However, Dittmar et al. (2003), Gill and Shah (2012), Megginson et al. (2014), and Pinkowitz et al. (2013) states that profitable companies tend to hold more cash. The study of Al-Amarneh (2015) shows both a positive and negative effect of ROA on cash holdings. The pecking order theory suggests that when ROA is higher, firms will have excess cash, and there is less need for external financing. Therefore, the pecking order theory predicts that there is a positive effect between ROA on cash holdings. Profitable companies mitigate the distress cost, and at the

same time, have enough cash to maintain investments, and therefore the tradeoff theory predicts a negative effect of ROA on cash holdings.

H4: *"ROA has a significant effect on cash holdings of similar directions throughout the periods"*

There is a consensus amongst literature that size has a negative effect on cash holdings (Dittmar et al., 2003; Ferreira & Vilela, 2004; Gill & Shah, 2012; Opler et al., 1999). The reason is that larger firms tend to have better profitability and economies of scale, thus better access to external capital at fair value. However, the study Al-Amarneh (2015) shows both a positive and negative relationship between size and cash holdings. In general, the pecking order theory suggests that companies choose internal capital before external capital. However, because there is less asymmetrical information in larger companies compared to smaller firms, larger firms have more incentives to select external capital as well as internal capital as a financing source. This is because less asymmetrical information reduces the mispricing of external capital and thus makes external capital less expensive. Therefore, the pecking order theory predicts that size has a positive effect on cash holdings. The tradeoff theory suggests that there are economies of scale for larger companies. Thus, larger companies can obtain external financing through debt cheaper than small firms because they are seen as less risky, and therefore the cost of debt is more inexpensive. Therefore, the tradeoff theory predicts a negative effect of size on cash holdings.

H5: *"Size has a significant effect on cash holdings of similar directions throughout the periods"*

Gill and Shah (2012) state that companies in a growth position need excess cash to survive and prosper, however, it is very sector-driven, and they find both a positive and negative relationship. This is in line with the study of Al-Amarneh (2015), which finds both a positive and negative effect of Tobin's Q on cash holdings. However, Opler et al. (1999), Ferreira and Vilela (2004) and Saddour (2006) find a positive relationship between growth opportunities and cash holdings. The reason is because of the need for excess cash to invest and hold cash due to higher risk.

The pecking order theory suggests that companies with a higher degree of investment opportunities want to invest by using internal capital instead of external capital and thus hold more cash. Therefore, the pecking order theory predicts a positive effect of Tobin's Q on cash holdings. Investments are often seen as riskier than cash, and therefore the tradeoff theory suggests that if the distress costs increase, there will also be necessary with a higher degree of cash. Therefore, the tradeoff theory predicts that Tobin's Q has a positive effect on cash holdings.

H6: *"Tobin's Q has a significant effect on cash holdings of similar directions throughout the periods"*

Research indicates that dividend yield is an essential factor for estimating the cash holdings, however, there is an ambiguous understanding about the direction it predicts. Ferreira and Vilela (2004), Bigelli and Sánchez-Vidal (2012), and Drobetz and Grüninger (2007) suggest a positive relationship between dividend yield and cash holdings. Further, Drobetz and Grüninger (2007) argue that companies that pay dividends are reluctant to do so, to hoarder cash to secure dividend payments in the future, thus higher cash holdings. On the other hand, Opler et al. (1999), Ozkan and Ozkan (2004), Al-Najjar and Belghitar (2011) and Tong (2014) show a negative relationship between dividend yield and cash holdings. These studies argue that companies who pay out dividends can easily reduce the dividend when they need cash. In the study of Al-Najjar and Belghitar (2011), the authors argue that the explanations for why there are different views on the dividend are that the pay-out ratio and cash holdings ratio are often set simultaneously. Indicating that dividend is set as a factor of cash holdings, while cash holdings are dependent on the dividend policy. Therefore, there could be significant variations between different sectors and companies. The pecking order theory also has ambiguous predictions on the effect of dividend yield on cash holdings. Firstly, when there is a need for cash, looking at dividends as internal capital could have a negative effect on cash holdings. On the other hand, dividend mitigates the asymmetrical information, which leads to lower costs when companies incur debt or have stock issues, which could lead to increased cash holdings. Therefore, the pecking order theory predicts both a positive and negative effect of dividend yield on cash holdings. The tradeoff theory suggests a negative relationship because when there

is a need for cash regarding investments, companies can reduce dividends to attain more cash. Therefore, the tradeoff theory predicts a negative effect of dividend yield on cash holdings.

H7: *"Dividend Yield has a significant effect on cash holdings of similar directions throughout the periods"*

Research shows ambiguous results of capital expenditures on cash holdings. Opler et al. (1999) and Al-Amarneh (2015) state that capital expenditures have both a positive and negative effect on cash holdings, while Dittmar et al. (2003) find a negative effect of capital expenditures on cash holdings. The pecking order theory suggests that companies with high capital expenditures can decrease capital expenditures or liquidate the capital to generate cash when needed, which is in line with turning to internal capital before external capital. Therefore, the pecking order theory predicts a negative effect of capital expenditures on cash holdings. The tradeoff theory suggests that companies with more capital expenditures have more liquid assets. This is because if companies have high investment activities or investment needs, they are in general in need of cash. Further, these investments are seen as risky, indicating higher distress costs if financed by debt. Therefore, the tradeoff theory predicts a positive effect of capital expenditures on cash holdings.

H8: *"Capital expenditure has a significant effect on cash holdings of similar directions throughout the periods"*

3. Data and descriptive statistics

3.1. Sample selection

The sample includes Norwegian firms listed on OSE within the time period 2001 until 2018. We have, through Datastream, collected accounting data from the EIKON database, which we have access to through BI Norwegian Business School. The database is a platform that offers financial information and data from around the world. Some of the data available in the database date back to 1980. The accounting data collected from EIKON is consolidated accounts. Not all the desired data were available in EIKON, therefore, we supplemented the dataset with data

from annual reports and Proff®Forvalt. Some of the firms reported their accounts in foreign currency, usually American dollars or Euros. In these cases, we have used Norges Bank's overview of exchange rates, which reported rates of 31.12 in each respective year were used (Norges Bank, 2021).

Per 31.12.2018, there were 193 firms listed on OSE. The downloaded samples were passed through several filters before we received our final sample. To better serve the purpose of investigating Norwegian firms and the consistency of regulations within countries, we decided to include only Norwegian firms listed on OSE. We exclude financial companies due to regulations and requirements to cash holdings. Additionally, we exclude real estate and holding companies due to their characteristics of holding high amounts of cash between investments. Lastly, we set a minimum demand of two consecutive years of accounting data because the regression model needs at least two consecutive years of observations.

When completing the sampling, we are presented with an unbalanced dataset, indicating an unequal set of observations each year (Hill, 2018). There are a total of 87 unique firms and 1121 observations in the sample. In table 1, there is an overview of the number of firm observations in each respective year.

Table 1: Observations per year 2001 to 2018

This table illustrates the number of firm observations in each year of the sampled period from 2001-2018. In 2001 there were 33 firms in our sample, while there were 87 firms in 2018.

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Observations	33	35	38	42	46	53	58	62	64	64	69	69	71	76	83	84	87	87

3.2. Variables

Cash holdings

The paper aims to investigate which determinants affect the cash holdings of Norwegian listed firms on OSE and if the 2008 financial crisis significantly impacted these determinants. There are several definitions of cash holdings of a firm. Opler et al. (1999) use cash and marketable securities as the definition of liquid assets, while Al-Amarneh (2015) use cash and cash equivalents. Due to data availability for our sample through Datastream, we use cash and cash equivalents as a measure of cash holdings. We also provide the measure of cash holdings as a

ratio of cash and cash equivalents in the numerator and net assets in the denominator. Net assets are defined as a firm's total assets net of cash and cash equivalents. We recognize the issue of using net assets found by Bates et al. (2009) that this definition of cash holdings possibly generates extreme outliers for firms where most of their assets are cash. We will therefore winsorize our cash holdings data to handle the outliers. When winsorizing the outliers, we choose to modify them to the 1-percentile level and 99-percentile level. This means that all observations of cash holdings below the 1-percentile level will be set equal to the 1-percentile value, while the observations above the 99-percentile will be modified to be equal to the 99-percentile value.

$$\frac{Cash\ \&\ cash\ equivalents_t}{Net\ assets_t}$$

Operating cash flow

Opler et al. (1999) and Bates et al. (2009) use the definition for operating cash flow as earnings after interest, dividends, and taxes, but before depreciation. Ferreira and Vilela (2004) use the definition of after-tax profits plus depreciation, while Al-Amarneh (2015) defines operating cash flow as net operating profit after tax (NOPAT) added to depreciation. This paper will use the same definition as Al-Amarneh (2015). This variable is presented as a ratio and is divided by net assets.

$$\frac{NOPAT_t - Depreciation_t}{Net\ assets_t}$$

Leverage

Al-Amarneh (2015) and Opler et al. (1999) use total debt as their basis for financial constraint in their study. Bates et al. (2009) use three different definitions, where the main difference is either using total debt or net debt, where net debt is defined as total debt net of cash. The definition of net debt also has the greatest impact on their results. We will, therefore, use the definition of net debt as leverage. The variable will be presented as a ratio, with net assets in the denominator.

$$\frac{Total\ debt_t - Cash\ \&\ cash\ equivalents_t}{Net\ assets_t}$$

NWC

When defining NWC, we use the exact definition as Opler et al. (1999), Ferreira and Vilela (2004), Bates et al. (2009) and Al-Amarneh (2015), where NWC is calculated by deducting cash and cash equivalents and current liabilities from current assets. NWC is a measure for liquid assets substitutes and is presented as a ratio with net assets in the denominator.

$$\frac{Current\ assets_t - Cash\ \&\ cash\ equivalent_t - Current\ liability_t}{Net\ assets_t}$$

ROA

We define the return on assets (ROA) ratio as net income in the numerator and net assets in the denominator aligned with Al-Amarneh (2015).

$$\frac{Net\ income_t}{Net\ assets_t}$$

Size

Opler et al. (1999) and Bates et al. (2009) use the natural logarithm of assets as a measure of firm size. In contrast, Al-Amarneh (2015) uses the natural logarithm of net assets to measure firm size. This paper will follow Al-Amarneh (2015) approach and use the natural logarithm of net assets.

Tobin's Q

As a variable to measure growth opportunities, we follow Al-Amarneh (2015) and use Tobin's Q as a measure. The definition of Tobin's Q is a ratio with book value of debt added to the market value of equity in the numerator and book value of assets in the denominator. A Tobin's Q-ratio lower than one indicates that the cost of replacing a firm's assets is greater than the stock's value. This indicates that the stock is undervalued. A Tobin's Q-ratio higher than one indicates that the stock is overvalued.

$$\frac{Book\ value\ of\ debt_t + Marketvaule\ of\ equity_t}{Bookvalue\ of\ assets_t}$$

Dividend yield

We see that Opler et al. (1999) and Bates et al. (2009) both use a dividend dummy in their regressions, while Al-Amarneh (2015) use the actual reported dividend

yield. We have chosen to use the reported dividend yield in this paper. Al-Amarneh (2015) defines dividend yield as the ratio with dividends in the numerator and stock price in the denominator.

$$\frac{Dividend_t}{Stock\ price_t}$$

Capital expenditure

Capital expenditures are a measure for investment activities and align with Al-Amarneh (2015), we define capital expenditures as the annual change in fixed assets added to depreciation in the numerator and total assets in the denominator.

$$\frac{Fixed\ assets_t - Fixed\ assets_{t-1} + Depreciation_t}{Total\ assets_t}$$

Table 2: Variable definition

This table provides a definition of variables used in the paper. The table presents definitions for the variables: Cash ratio as a measure for cash holdings, operating cash flow as a measure for companies operations, leverage as a measure of debt, net working capital (NWC) as a measure for liquid substitutes, return on assets (ROA) as a measure for profitability, firms size will indicate a firm's financial constraints, Tobin's Q as a measure for growth opportunities, and capital expenditures as a measure for investment activities.

Variable	Full Name	Description	Predicting
Cashholdings	Cash holdings	Cash and cash equivalents / Net assets	Cash holdings
Operating CF	Operating cash flow	(NOPAT + Depreciation) / Net assets	Business operations
Leverage	Leverage	(Total debt - Cash & cash equivalents) / Net assets	Financial leverage
NWC	Net Working Capital	(Current assets - Cash & cash equivalents - current liability) / Net assets	Liquid Asset Substitutes
ROA	Return On Assets	Net income / Net assets	Profitability
SIZE	Firm size	Natural logarithm of Net assets	Financial constraint
TobinsQ	Tobin's Q	(Book value of debt + Marketvalue of equity) / Bookvalue of assets	Long-term growth
Divyield	Dividend Yield	Dividends paid / Stock price	Financial constraint
CapExp	Capital Expenditure	The annual change in fixed assets added to depreciation / Total assets	Investment Activity

3.3. Descriptive statistics

To illustrate cash holdings for Norwegian listed firms before, during and after the 2008 financial crisis, we divide the sample into four sub-periods: Base period (2001-2003), Pre-crisis period (2004-2006), Crisis period (2007-2009), and Post-crisis period (2010-2018). As table 3 shows, Norwegian listed firms hold on average about (21.8%) of net assets in cash. Bates et al. (2009) find that US firms doubled their average cash holdings from 1980 (10.5%) to 2006 (23.2%) of their

net assets. During the Base period, average cash holding was about (20.2%), during the Pre-crisis period, cash holdings increased to (32.2%) before it decreased to approximately (25.3%) in the Crisis period and further decreased to (19%) in the Post-crisis period to the approximately same level as the Base period.

Table 3: Descriptive statistics over time periods for cash holdings

The table presents descriptive statistics (mean, median, minimum value, maximum value, standard deviation) for cash holdings of for the entire sample period (2001-2018) and in each sub-period. Cash holdings is defined as cash & cash equivalents divided by net assets. The sub-periods are based on year-intervals, where the Base period interval is 2001-2003, Pre-crisis period interval is 2004-2006, Crisis period interval is 2007-2009, and the Post-crisis interval is 2010-2018. The sample consists of Norwegian firms listed on Oslo Stock Exchange. Cash holdings have been winsorized at the 1%- and 99%-percentile.

Time Period	Mean	Median	Minimum	Maximum	Std.Dev.
Base Period	0.202313	0.1126591	0.0088996	1.791183	0.2861551
Pre crisis period	0.3219871	0.161117	0.0139173	2.301946	0.4412629
Crisis period	0.2528485	0.1113528	0.0088996	2.301946	0.4121268
Post crisis period	0.1905577	0.1090854	0.0088996	2.301946	0.2963577
All	0.2184249	0.113551	0.0088996	2.301946	0.3403609

Figure 1 shows the average cash holding ratio for each year, illustrating a rapid increase in cash holdings from 2002 until 2004, where it peaked at (36.3%). The average cash holdings then decreased the year after, in 2005, before there was a minor increase in 2006, there was a rapid decrease during the 2008 financial crisis, until 2010, where cash holdings stabilized.

Further, Figure 1 illustrates the difference in cash holdings for small and large firms from 2001 to 2018. Distinctly, small firms are much more volatile in their cash holdings than large firms. The common features are the decline in cash holdings from 2001 till 2002. Then there is a major increase in cash for small firms from (22.3%) in 2002 to (43.7%) in 2008, with a peak of cash holdings of (49.8%) in 2004. Large firms have a steady increase in their cash holdings from (11.2%) in 2002 to (17.3%) in 2007, where it peaked. Small firms increased cash from 2007 to 2008 before decreasing in 2009 and 2010. Large firms have a large decrease in their cash holdings from 2007 to 2008, then it stabilizes. Hence, both small and large firms have an increase in cash holdings during the Pre-crisis period, and both have an overall decrease in cash holdings in the Crisis period before it stabilizes in the Post-crisis period.

Figure 1: Mean cash holdings year-to-year (2001-2018)

The figure shows graphicly mean cash holdings year-to-year from 2001 to 2018 for the overall mean, and the mean for large firms, defined as firms with larger net assets than the mean of the entire sample, and small firms defined as firms with smaller net assets than the mean of the entire sample. Cash holdings is defined as cash & cash equivalents divided by net assets. Mean cash holdings of the entire year sample is presented with the fully drawn line, mean cash holdings for each year for large firms is presented by the dashed line, mean cash holdings for each year for small firms is presented by the dotted line. Cash holdings have been winsorized at the 1%- and 99%-percentile. The sample consists of Norwegian firms listed on Oslo Stock Exchange.
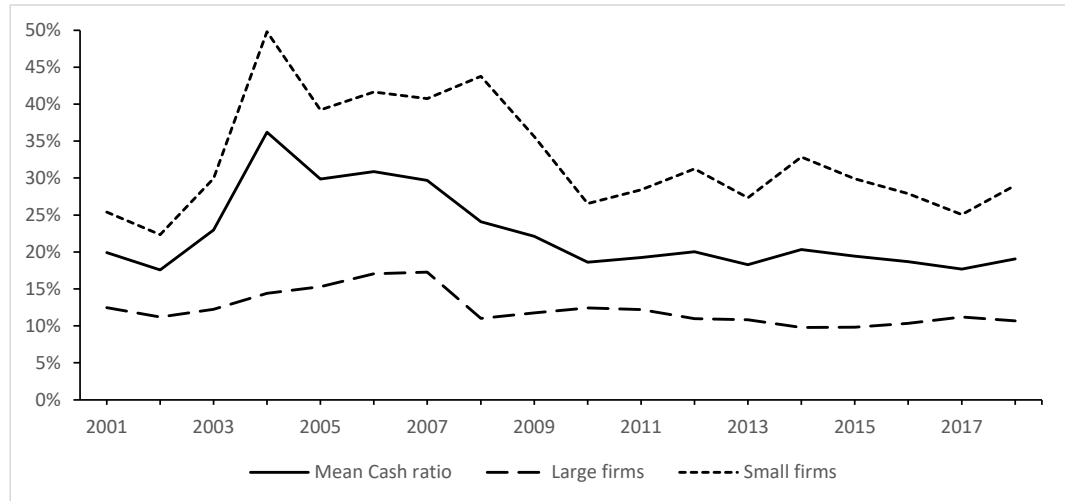
Table 4 illustrates that on average Norwegian listed firms hold (21.8%) of net assets in cash. The mean cash holdings represent approximately 4,664 million NOK in corporate cash holdings on average. Moreover, the average net assets for the investigated firms is approximately 21,354 million NOK. The leverage had an average holding of (45.37%), and the NWC is negatively represented (-2.34%) of net assets for Norwegian listed firms.

Table 4: Descriptive statistics for all variables (2001-2018)

The table shows descriptive statistics (Mean, median, minimum value, maximum value) for the variables; cash holdings being the ratio of cash & cash equivalents to net assets operating cash flow which is the ratio of NOPAT to net assets, leverage is the ratio of total dept to net assets, NWC is the ratio of current assets less cash & cash equivalents less current liability to net assets, ROA is the ratio of net income to net assets, size is the natural logarithm of net assets, Tobin's Q is the ratio of book value of debt added to the market value of equity to total assets, dividend yield is the ratio of dividend paid to stock price, capital expenditures is the ratio of annual change in fixed assets added to depreciation to total assets, for the entire sample period (2001-2018). Cash holdings have been winsorized at the 1%- and 99%-percentile. The sample consists of Norwegian firms listed on Oslo Stock Exchange.

| Variable	Mean	Median	Minimum	Maximum
Cash holdings	0.2184249	0.113551	0.0088996	2.301946
Operating cash flow	0.0860286	0.0968192	-2.556687	4.844789
Leverage	0.453727	0.5344339	-12.09859	3.583577
NWC	-0.0233799	-0.0397462	-2.116644	0.7080323
ROA	0.0380704	0.0335038	-3.78692	56.05634
Size	14.90443	14.99623	8.86785	20.53198
Tobin's Q	1.544932	1.226187	0.2641552	11.58774
Dividend Yield	0.0229429	0.0104	0.000	1.350900
Capital Expenditure	0.0513946	0.0672201	-12.66904	0.7446933

This indicates that Norwegian firms hold more cash and cash equivalents on average than other liquidity substitutes. The average ROA is approximately (3.8%), and the dividend yield has an average of (2.3%). In the same period, the Norwegian firms had an average Tobin's Q of (1.54), indicating investment opportunities. The average yearly percentage change in capital expenditure was approximately (5.2%), and the average operating cash flow was (8.6%) of firms net assets across the investigated time period.

3.3.1. Correlation matrix

Table 5 shows the correlation coefficients for cash holdings and relevant determinants in this paper. All coefficients are tested at a 5% level, and significant coefficients are marked with a star. The matrix reveals some apparent results, such as the negative correlation between cash holdings and size. This is in line with the theory of economy of scale (Preve & Sarria-Allende, 2010), that increase in assets decreases the cash holdings needed to operate companies. Further, we see a negative correlation between the cash holdings and leverage. Overall, the correlation matrix indicates corporate cash holdings are positively correlated with ROA and Tobin's

Q at a significant level and negatively correlated with operating cash flow, leverage, NWC, size, and capital expenditures at a significant level.

The majority of the correlation between the variables is low. However, the correlation between ROA and operating cash flow (0.6280) is high. These variables are built up by many of the same categories of accounting data, influencing their values. To investigate if each variable's estimation effect is affected by each other, we test for multicollinearity within the determinants. This is tested through a variance inflation factor (VIF) - test.

Table 5: Correlation matrix

This table shows the correlation coefficients used in the regression analysis. Cash holdings being the ratio of cash & cash equivalents to net assets operating cash flow which is the ratio of NOPAT to net assets, leverage is the ratio of total dept to net assets, NWC is the ratio of current assets less cash & cash equivalents less current liability to net assets, ROA is the ratio of net income to net assets, size is the natural logarithm of net assets, Tobin's Q is the ratio of book value of debt added to the market value of equity to total assets, dividend yield is the ratio of dividend paid to stock price, capital expenditures is the ratio of annual change in fixed assets added to depreciation to total assets. Cash holdings have been winsorized at the 1%- and 99%-percentile. The sample period is 2001 to2018. The sample consists of Norwegian firms listed on Oslo Stock Exchange.

	Cash ratio	Operating cash flow	Leverage	NWC	ROA	SIZE	Tobin's Q	DIVYIELD	CapExp
Cash holdings	1.0000								
Operating cash flow	-0.0589*	1.0000							
Leverage	-0.6280*	-0.0035	1.0000						
NWC	-0.0829*	-0.0831*	-0.2933*	1.0000					
ROA	0.1450*	0.6280*	-0.3512*	-0.0977*	1.0000				
SIZE	-0.4399*	0.0994*	0.2613*	0.0084	-0.0460	1.0000			
Tobin's Q	0.4354*	-0.0234	-0.3555*	0.0990*	0.0478	-0.3729*	1.0000		
DIVYIELD	-0.0498	0.0554	0.0458	-0.0113	0.0015	0.0739*	-0.0736*	1.0000	
CapExp	-0.1655*	0.1144*	-0.0386	0.0476	0.0183	0.0091	0.0460	0.0337	1.0000

The VIF-test starts at a value of one and increases. A value of one indicates that the value of that variable cannot be explained by the other variables (Hill, 2018). According to (Hill, 2018), if the value of a variable is affected by over 90% by the variance of another variable, then the VIF-value will exceed ten. Table 6 illustrates the VIF-test on our variable, with relatively low values, indicating no multicollinearity in our model.

Table 6: Variance influence factor (VIF)

This table shows the results of the variance influence factor (VIF)-test, performed on the variables ROA, operating cash flow, leverage, Tobin's Q, size, NWC, capital expenditures, and dividend yield. Cash holdings being the ratio of cash & cash equivalents to net assets operating cash flow which is the ratio of NOPAT to net assets, leverage is the ratio of total dept to net assets, NWC is the ratio of current assets less cash & cash equivalents less current liability to net assets, ROA is the ratio of net income to net assets, size is the natural logarithm of net assets, Tobin's Q is the ratio of book value of debt added to the market value of equity to total assets, dividend yield is the ratio of dividend paid to stock price, capital expenditures is the ratio of annual change in fixed assets added to depreciation to total assets. The test indicates if there is multicollinearity between the chosen variables. A VIF-value over 10 is an indication of multicollinearity. The sample consists of Norwegian firms listed on Oslo Stock Exchange.

Variable	VIF	1/VIF
ROA	2.41	0.42
Operating cash flow	2.06	0.49
Leverage	1.7	0.59
Tobinsq	1.29	0.78
Size	1.22	0.82
NWC	1.18	0.85
CapExp	1.03	0.97
DivYield	1.01	0.99
Mean VIF	1.49	

4. Methodology

In this paper, we analyze Norwegian listed firms on Oslo Stock Exchange (OSE) in the period 2001 to 2018 to investigate which determinants affect corporate cash holdings before, during, and after the 2008 financial crisis. To investigate this, similarly to Al-Amarneh (2015), we divide the sample into four sub-periods. The first period is 2001-2003, which is called the Base period. The second period, 2004-2006, is called the Pre-crisis period. The third period, 2007-2009, is called the Crisis period. Moreover, the fourth period, 2010-2018, is the Post-crisis period. The motivation of the periods is to investigate if there is a difference in the different periods to see if the 2008 financial crisis affected corporate cash holdings. Since the different firms' accounting data is observed over time, the dataset is categorized as panel data. We can then perform a panel data regression to investigate the determinants of corporate cash holdings across the different time periods.

4.1. Regression model

The model we are going to use to research our hypotheses is as follows:

$$CASH_{i,t} = \beta_0 + \beta_1 OperatingCF_{i,t} + \beta_2 Leverage_{i,t} + \beta_3 NWC_{i,t} + \beta_4 ROA_{i,t} + \beta_5 Size_{i,t} +$$
$$\beta_6 Tobins\acute{}sQ_{i,t} + \beta_7 DivYield_{i,t} + \beta_8 CapExp_{i,t} + \alpha_1 Industry_{i,t} + \mu_{i,t}$$

Where $\mu_{i,t} = u_i + e_{i,t}$, and u_i is unit specific error term, and $e_{i,t}$ is the unobserved time-variant error term of the model, *i* is the firm indicator, and *t* is the time indicator (Hill, 2018, p. 647). Industry$_{i,t}$ is a vector of industry dummies. The industry dummies are seven individual dummies to control for the seven different industries within our dataset. We have classified each firm within the given industry registered on OSE, and the seven different industries controlled for are Energy, Industry, Basic materials, Consumer goods, Healthcare, Technology, and Communication.

When deciding upon which regression model to use to answer our research question, there are three main to choose from, namely Pooled Ordinary Least Squares (POLS), Fixed Effects (FE), and Random Effect (RE) (Adkins & Hill, 2011). When choosing a regression method, we can perform a Hausman-test, which tests for endogeneity, and indicates if FE or RE is most fitted for our data.

The test indicates that there is endogeneity in our model. Endogeneity can be defined as a correlation between the explanatory variables and the error term in the regression and is arguably one of the main issues in studies within corporate finance (Roberts & Whited, 2013). Therefore, the Hausman-test indicates that the most appropriate model for our data is the FE model, but we cannot perform a FE regression due to our time-invariant dummy variables. The FE regression treats the variable specific effects as constant over time, and in praxis, removes the time-invariant error term (u_i) (Hill, 2018, pp. 640-646). Therefore, the FE model removes time-invariant variables, making it unfit for our purpose. The RE model enables estimations of time-invariant variables and considers the unobserved individual effects (Hill, 2018, p. 647). Therefore, we will perform a RE regression when answering our research questions but recognize that the estimations might contain bias due to endogeneity. A common way to eliminate or reduce the correlation between the explanatory variable and the error term is to lag the explanatory

variables. We, therefore, lag the variables: leverage, NWC, size, Tobin's Q, and dividend yield. Hence, we present a new regression model:

$$CASH_{i,t} = \beta_0 + \beta_1 OperatingCF_{i,t} + \beta_2 Leverage_{i,t-1} + \beta_3 NWC_{i,t-1} + \beta_4 ROA_{i,t} + \beta_5 Size_{i,t-1} +$$
$$\beta_6 Tobins\acute{}sQ_{i,t-1} + \beta_7 DivYield_{i,t-1} + \beta_8 CapExp_{i,t} + \alpha_1 Industry_{i,t} + \mu_{i,t}$$

5. Results

5.1. Regression analysis

The results from the regression are presented in table 7. The regression is performed for each sub-period to capture the potential change in the effect and significance for each explanatory variable. The R-squared presented at the bottom of table 7 is the overall R-squared.

We see that the coefficient operating cash flow is significant at respectively 5% level and 1% level in the Pre-crisis- and Post-crisis period. However, in the Base- and Crisis periods, operating cash flow was not significant. Additionally, we see that operating cash flow positively affects cash holdings in the Pre-crisis period, supportive of the pecking order theory, while the effect changes to a negative effect in the Post-crisis period, supportive of the tradeoff theory. We, therefore, reject hypothesis 1 due to the change in both significance and direction. The coefficient leverage is significant at a 1% level for all periods. Additionally, the negative effect indicates that leverage supports both the pecking order theory and the tradeoff theory. Due to the consistency of significance and direction in all periods, we accept hypothesis 2. We see that the coefficient of NWC is significant at a 1% level in the Base- and Post-crisis period. However, in the Pre-crisis- and Crisis period, NWC is insignificant. Further, the NWC is supportive of the tradeoff theory in the Base- and Post-crisis periods due to a negative effect on cash holdings. We reject hypothesis 3 since NWC has periods that are insignificant. The coefficient ROA is only significant in the Crisis period at a 1% level. However, for the rest of the periods, there is no significant effect of ROA on cash holdings. Additionally, the positive ROA on cash holdings indicates that the variable is supportive of the pecking order theory. Due to ROA being insignificant in Base-, Pre-crisis- and Post-crisis period, we reject hypothesis 4. We confirm hypothesis 5 because the coefficient of size has

a significant negative effect for all periods at a 1% level. Additionally, due to the negative effect on cash holdings, size is in line with the tradeoff theory. We see that the coefficient Tobin's Q is significant at 5% level for the Base- and Crisis period and 1% level for the Post-crisis period. However, not for the Pre-crisis period. Tobin's Q is supportive of the tradeoff theory and the pecking order theory for the significant periods due to a positive effect on cash holdings. We reject hypothesis 6 because Tobin's Q have insignificant periods. We reject hypothesis 7 because dividend yield is insignificant for all periods. Capital expenditures are significant at a 1% level for the Base-, Crisis- and Post-crisis period and 5% level for the Pre-crisis period. A negative effect of capital expenditures on cash holdings is supportive of the pecking order theory. Due to consistent significance and direction in all periods, we accept hypothesis 8.

Table 7: Main regression

The table reports estimate on the selected regression model presented in the methodology section. The dependent variable is cash holdings, the explanatory variables are operating cash flow, leverage, NWC, ROA, size, Tobin's Q, dividend yield, and capital expenditures. Cash holdings being the ratio of cash & cash equivalents to net assets operating cash flow which is the ratio of NOPAT to net assets, leverage is the ratio of total dept to net assets, NWC is the ratio of current assets less cash & cash equivalents less current liability to net assets, ROA is the ratio of net income to net assets, size is the natural logarithm of net assets, Tobin's Q is the ratio of book value of debt added to the market value of equity to total assets, dividend yield is the ratio of dividend paid to stock price, capital expenditures is the ratio of annual change in fixed assets added to depreciation to total assets. The variables leverage, NWC, size, Tobin's Q, and dividend yield are lagged with one period. There are seven industry dummies in the model controlling for industry effect. The column labelled by Base period estimated the explanatory variables effect on the dependent variable for the period 2001 to 2003. The column labelled by Pre-crisis period estimated the explanatory variables effect on the dependent variable for the period 2004 to 2006. The column labelled by Crisis period estimated the explanatory variables effect on the dependent variable for the period 2007 to 2009. The column labelled by Post-crisis period estimated the explanatory variables effect on the dependent variable for the period 2010 to 2018. Each coefficient is tested for significance and are marked with stars if they are significant at a *0.1, **0.05, ***0.01 level. The sample consists of Norwegian firms listed on Oslo Stock Exchange.

Sample sub-period	Base period	Pre-crisis period	Crisis period	Post-crisis period
Variable				
Operating CF$_t$	-0.2369	0.4672**	-0.2708*	-0.1573***
Leverage$_{t-1}$	-0.2760***	-0.2041***	-0.3833***	-0.2216***
NWC$_{t-1}$	-0.3395***	-0.0174	-0.1713	-0.3801***
ROA$_t$	0.2707	0.0653	0.5932***	0.0094
SIZE$_{t-1}$	-0.0234**	-0.0686***	-0.0523***	-0.0379***
Tobin's Q$_{t-1}$	0.0351**	-0.0078	0.0287**	0.0481***
DivYield$_{t-1}$	0.3248*	-1.2449	0.1283	0.1047
CapExp$_t$	-0.1702***	-0.2681**	-0.3774***	-0.1060***
C	0.6020***	1.5416***	1.3797***	0.7610***
R-squared	0,8002	0,6329	0,7779	0,5942
Sample size	35	46	62	87
Industry dummy	Yes	Yes	Yes	Yes

5.2. Further analysis

Our results show a relatively large difference in which effect the explanatory variables have on cash holdings. However, further analysis is needed to indicate further how the determinants affect cash holdings throughout the periods and which theories support the effect. Literature states that larger, more profitable firms with lower growth opportunities tend to support the tradeoff theory, while smaller firms with lower profitability and larger growth opportunities tend to support the pecking order theory. Therefore, we will now show the results of further analyses, where we conduct the same regression again, only taking into account the firm's characteristics: size, where we divide the sample into small and large firms, defined as below and above the average size for the sample; profitability, where we divide the sample into Low and High ROA firms, defined as below and above the average ROA for the sample; and growth opportunities, where we divide the sample into Low and High Tobin's Q firms, defined as below and above the average Tobin's Q for the sample. Due to a relatively small sample size, we will accept results at a 10% level.

5.2.1. Firm size

Table 8 shows that operating cash flow has a significant effect on cash holdings in the Pre-crisis-, Crisis-, and Post-crisis period for small firms but is only significant in the Pre-crisis for large firms. Notably, in the Pre-crisis period, operating cash flow positively affects cash holdings for small firms and negatively affects large firms. However, in the Crisis period, the effect turned from positive to negative on small firms and continues to be negative in the Post-crisis period. This indicates that in the Pre-crisis period operating cash flow for small firms were supportive of the pecking order theory, while large firms were supportive of the tradeoff theory. Further, during the Crisis period, small firms also turned to the tradeoff theory. The coefficient leverage is significant in all periods for small firms. However, it has only a significant effect on cash holdings during the Crisis- and Post-crisis period for large firms. Notably, NWC had a significant effect on cash holdings for large firms in the Pre-crisis period, but not in the Crisis- or Post-crisis period. Contrastingly, for small firms, NWC is insignificant in the Pre-crisis period but becomes significant in the Crisis- and Post-crisis period. Contrasting the main results in table 8, where ROA was only significant in the Crisis period, the

coefficient is also significant in the Post-crisis period for large firms. We see that size significantly affects cash holdings for small firms in all periods, while for large firms, size only becomes significant in the Post-crisis period. Notably, the negative sign on size is supportive of the tradeoff theory. Additionally, in contrast to the main results in table 8, capital expenditures are not significant for small firms in the Pre-crisis period, but are significant in the Crisis- and Post-crisis period. However, capital expenditures are significant for large firms in the Pre- and Post-crisis period, but not during the Crisis period.

Table 8: Regression on firm size

The table reports estimate on the selected regression model presented in the methodology section. The dependent variable is cash holdings, the explanatory variables are operating cash flow, leverage, NWC, ROA, size, Tobin's Q, dividend yield, and capital expenditures. Cash holdings being the ratio of cash & cash equivalents to net assets operating cash flow which is the ratio of NOPAT to net assets, leverage is the ratio of total dept to net assets, NWC is the ratio of current assets less cash & cash equivalents less current liability to net assets, ROA is the ratio of net income to net assets, size is the natural logarithm of net assets, Tobin's Q is the ratio of book value of debt added to the market value of equity to total assets, dividend yield is the ratio of dividend paid to stock price, capital expenditures is the ratio of annual change in fixed assets added to depreciation to total assets. The variables leverage, NWC, size, Tobin's Q, and dividend yield are lagged with one period. There are seven industry dummies in the model controlling for industry effect. The column labelled by Base period estimated the explanatory variables effect on the dependent variable for the period 2001 to 2003. The column labelled by Pre-crisis period estimated the explanatory variables effect on the dependent variable for the period 2004 to 2006. The column labelled by Crisis period estimated the explanatory variables effect on the dependent variable for the period 2007 to 2009. The column labelled by Post-crisis period estimated the explanatory variables effect on the dependent variable for the period 2010 to 2018. Further, within each period the table show estimates on large firms, defined as firms with larger net assets than the mean of the entire sample, and small firms defined as firms with smaller net assets than the mean of the entire sample. Each coefficient is tested for significance and are marked with stars if they are significant at a *0.1, **0.05, ***0.01 level. The sample consists of Norwegian firms listed on Oslo Stock Exchange.

Sample sub-period	Base period		Pre-crisis period		Crisis period		Post-crisis period	
Variable	Small Firms	Large Firms	Small Firms	Large Firms	Small Firms	Large Firms	Small Firms	Large Firms
Operating CF$_t$	-0.2409	0.3442	0.7145**	-0.7606***	-0.4202*	0.0084	-0.2065***	0.0208
Leverage$_{t-1}$	-0.2939***	0.0618	-0.1986***	-0.1089	-0.4443***	-0.1172**	-0.2078***	-0.0479*
NWC$_{t-1}$	-0.3117*	-0.2699*	-0.0500	-0.6434***	-0.3774**	-0.0750	-0.4092***	-0.0297
ROA$_t$	0.3898	0.0604	-0.0671	0.0422	0.7276***	0.5085**	0.0111	0.1664***
SIZE$_{t-1}$	-0.0437*	-0.0187	-0.1028***	-0.0044	-0.0954*	0.0016	-0.0790***	-0.0176***
Tobin's Q$_{t-1}$	0.0362**	-0.1117	-0.0107	0.1136*	0.0433**	-0.0052	0.0585***	-0.0046
DivYield$_{t-1}$	0.1219	-0.2661	-2.3766	-0.7255	0.3522	-1.0045	0.1301	-0.1323
CapExp$_t$	-0.1633*	-0.0138	-0.2715	-0.2236**	-0.6317***	-0.0659	-0.1157***	-0.1035***
C	0.9105***	0.4603	2.1627***	0.1478	2.0798***	0.1174	1.3534***	0.4395***
R-squared	0.883	0.8324	0.6983	0.6169	0.8535	0.2855	0.6162	0.1584
Sample size	20	15	28	21	31	38	45	53
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

5.2.2. Firm profitability

Table 9 shows that operating cash flow has a significant effect on cash holdings for High ROA firms in the Base- and Post-crisis period. However, for Low ROA firms, operating cash flow is significant in the Crisis- and Post-crisis period. Further, the analysis indicates that for low ROA firms, leverage has a significant effect on cash holdings in the Base-, Pre-crisis- and Post-crisis periods. High ROA firms are significant in the Pre-crisis-, Crisis- and Post-crisis period. For High ROA firms, NWC is only significant for cash holdings in the Pre-crisis period, while for Low ROA firms, NWC is significant in the Base-, Crisis- and Post-crisis period. We see that for Low ROA firms, ROA is significant in the Crisis- and Post-crisis period, while High ROA firms are significant in the Pre-crisis period. Further, the results indicate that size significantly affects cash holdings for both Low and High ROA firms in the Crisis- and Post-crisis period. However, in the Pre-crisis period, size is only significant for High ROA firms. Notably, in contrast with the main results in table 7, where dividend yield did not significantly affect cash holdings in any of the studied periods, the variable is now significant for both Low ROA and High ROA firms. Capital expenditures are not significant for cash holdings in the Pre-crisis period for either High ROA or Low ROA firms, while it turns to a significant effect for both High ROA and Low ROA firms in the Crisis- and Post-crisis period.

Table 9: Regression on ROA

The table reports estimate on the selected regression model presented in the methodology section. The dependent variable is cash holdings, the explanatory variables are operating cash flow, leverage, NWC, ROA, size, Tobin's Q, dividend yield, and capital expenditures. Cash holdings being the ratio of cash & cash equivalents to net assets operating cash flow which is the ratio of NOPAT to net assets, leverage is the ratio of total dept to net assets, NWC is the ratio of current assets less cash & cash equivalents less current liability to net assets, ROA is the ratio of net income to net assets, size is the natural logarithm of net assets, Tobin's Q is the ratio of book value of debt added to the market value of equity to total assets, dividend yield is the ratio of dividend paid to stock price, capital expenditures is the ratio of annual change in fixed assets added to depreciation to total assets. The variables leverage, NWC, size, Tobin's Q, and dividend yield are lagged with one period. There are seven industry dummies in the model controlling for industry effect. The column labelled by Base period estimated the explanatory variables effect on the dependent variable for the period 2001 to 2003. The column labelled by Pre-crisis period estimated the explanatory variables effect on the dependent variable for the period 2004 to 2006. The column labelled by Crisis period estimated the explanatory variables effect on the dependent variable for the period 2007 to 2009. The column labelled by Post-crisis period estimated the explanatory variables effect on the dependent variable for the period 2010 to 2018. Further, within each period the table show estimates on Low and High ROA firms. Low ROA firms defined as firms with ROA lower than the sample mean of ROA, and High ROA firms defined as firms with ROA higher than the sample mean of ROA. Each coefficient is tested for significance and are marked with stars if they are significant at a *0.1, **0.05, ***0.01 level. The sample consists of Norwegian firms listed on Oslo Stock Exchange.

Sample sub-period	Base period		Pre-crisis period		Crisis period		Post-crisis period	
Variable	Low ROA	High ROA	Low ROA	High ROA	Low ROA	High ROA	Low ROA	High ROA
Operating CF$_t$	-0.0684	-0.3571	-0.6500	0.4637***	-0.7606***	0.3948	-0.5261***	0.4160***
Leverage$_{t-1}$	0.2219***	-0.1545	-0.1840***	-0.3088***	0.0808	-0.2779***	-0.2601***	-0.0713**
NWC$_{t-1}$	-0.2853*	-0.1321	0.3483	-0.3287***	0.3444***	-0.2147	-0.3436***	-0.0891
ROA$_t$	0.0372	-1.9611	-0.5813	0.7643***	0.7266***	0.0613	0.2294***	-0.0092
SIZE$_{t-1}$	-0.0268*	-0.0034	-0.0120	-0.0395**	-0.0630***	-0.0543***	-0.0304***	-0.0441***
Tobin's Q$_{t-1}$	0.0937*	0.0642***	0.0045	-0.0053	-0.0013	-0.0113	0.0171	0.0170
DivYield$_{t-1}$	0.1034	0.9124	-1.1110	-1.5404	3.0588**	0.6355**	0.0449	0.2371
CapExp$_t$	0.0365	0.3275***	-0.1742	-0.1145	-0.2677***	-0.1761**	-0.1010***	-0.2353***
C	0.5007*	0.3761*	0.9357	0.8289***	1.1346***	1.4902***	0.6843***	0.8640***
R-squared	0.8725	0.8001	0.7849	0.7462	0.7510	0.8061	0.6533	0.5552
Sample size	24	21	26	41	42	47	76	74
Industry dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

5.2.3. Firm growth potential

We can see from the regression results in table 10 that operating cash flow has no significant effect on cash holdings for Low Tobin's Q firms in any of the periods. However, we can see a significant effect in the Pre-, Crisis-, and Post-crisis period for High Tobin's Q firms. Notably, we see that in the Pre-crisis period there is a negative effect, while it turns positive in the Crisis- and Post-crisis period, in line with the main results. NWC has no significant effect on cash holdings for neither Low nor High Tobin's Q firms in the Base- and Pre-crisis period, however, it turns to a significant effect in the Crisis- and Post-crisis period for both firm characteristics. Notably, ROA has only a significant effect in the Crisis period for High Tobin's Q firms. For High Tobin's Q firms, capital expenditure significantly affects cash holdings during the Crisis period.

Table 10: Regression on Tobin's Q

The table reports estimate on the selected regression model presented in the methodology section. The dependent variable is cash holdings, the explanatory variables are operating cash flow, leverage, NWC, ROA, size, Tobin's Q, dividend yield, and capital expenditures. Cash holdings being the ratio of cash & cash equivalents to net assets operating cash flow which is the ratio of NOPAT to net assets, leverage is the ratio of total dept to net assets, NWC is the ratio of current assets less cash & cash equivalents less current liability to net assets, ROA is the ratio of net income to net assets, size is the natural logarithm of net assets, Tobin's Q is the ratio of book value of debt added to the market value of equity to total assets, dividend yield is the ratio of dividend paid to stock price, capital expenditures is the ratio of annual change in fixed assets added to depreciation to total assets. The variables leverage, NWC, size, Tobin's Q, and dividend yield are lagged with one period. There are seven industry dummies in the model controlling for industry effect. The column labelled by Base period estimated the explanatory variables effect on the dependent variable for the period 2001 to 2003. The column labelled by Pre-crisis period estimated the explanatory variables effect on the dependent variable for the period 2004 to 2006. The column labelled by Crisis period estimated the explanatory variables effect on the dependent variable for the period 2007 to 2009. The column labelled by Post-crisis period estimated the explanatory variables effect on the dependent variable for the period 2010 to 2018. Further, within each period the table show estimates on Low and High Tobin's Q firms. Low Tobin's Q firms defined as firms with Tobin's Q lower than the sample mean of Tobin's Q, and High Tobin's Q firms defined as firms with Tobin's Q higher than the sample mean of Tobin's Q. Notably, in the Base period (2001-2003) there were not enough observations of firms with High Tobin's Q to estimate. Each coefficient is tested for significance and are marked with stars if they are significant at a *0.1, **0.05, ***0.01 level. The sample consists of Norwegian firms listed on Oslo Stock Exchange.

Sample sub-period	Base period		Pre-crisis period		Crisis period		Post-crisis period	
Variable	Low Tobin's Q	High Tobin's Q	Low Tobin's Q	High Tobin's Q	Low Tobin's Q	High Tobin's Q	Low Tobin's Q	High Tobin's Q
Operating CF_t	-0.0467	-	0.0358	0.6524*	0.3380	-0.6439***	0.1371	-0.3370***
Leverage$_{t-1}$	-0.1933**	-	-0.2129*	-0.1526**	-0.3052***	-0.3610***	-0.1117***	-0.3248***
NWC$_{t-1}$	-0.2390**	-	-0.1617	-0.0410	-0.2497**	-0.3699*	-0.1404***	-0.4938***
ROA$_t$	0.2850	-	0.2566	0.0078	0.3638	0.8660***	0.0455	0.0105
Size$_{t-1}$	-0.0207*	-	-0.0304	-0.1081**	-0.0250**	-0.1233***	-0.0307***	-0.0439***
Tobin's Q$_{t-1}$	0.0461	-	0.1739***	-0.0268	-0.0323	0.0289	0.0808***	0.0474***
DivYield$_{t-1}$	0.0355	-	0.0807	-9.4395	0.0247	0.8533	0.0577	0.6200
CapExp$_t$	-0.2238***	-	-0.2270**	-0.1274	-0.2956***	-0.2602*	-0.1217***	-0.0012
C	0.4907**	-	0.5427	2.3688***	0.7376***	2.5899***	0.5405***	0.9029***
R-squared	0.5972		0.3556	0.7191	0.4769	0.8831	0.4393	0.7373
Sample size	33		36	23	53	36	78	50
Industry dummy	Yes		Yes	Yes	Yes	Yes	Yes	Yes

6. Discussion

In table 3, we see an increase in cash holdings from the Base period to the Pre-crisis period. This is in alignment with the findings of Bates et al. (2009), where U.S. firms doubled their cash holdings from 1980 to 2006. Further, Norwegian listed firms decreased their cash holdings from the Pre-crisis period (32%) to the Crisis period (25%). The decrease in cash holdings during the 2008 financial crisis is in alignment with the study of Campello et al. (2011) that find a decrease in cash holdings during the financial crisis. Further, our study observes a decrease in cash from the Crisis period (25%) to the Post-crisis period (19%). Notably, there is a change in standard deviation for the cash holdings during the different time periods. The Base- and Post-crisis period have a standard deviation of (0.28) and (0.29), while the Pre-crisis and Crisis period have a standard deviation of (0.44) and (0.41) illustrated in table 3. Indicating an increased difference between the different observations in the Pre-crisis and Crisis period than in the other periods. This can be observed in figure 1 for cash holdings between large and small firms. The difference in cash holdings between large and small firms increased during the Pre-crisis- and Crisis period, while it decreased in the Post-crisis period. Further, small firms fluctuate more than large firms, which are more stable year-to-year, where the standard deviation of mean cash holdings was (0.0042) for large firms and (0.0194) for small firms. This could be explained by the fact that small firms will not take full advantage of the economies of scale and thus hold more cash. Additionally, smaller firms are expected to be more affected by the short-term change in the economic environment than larger firms.

The results show that operating cash flow has a positive effect on cash holdings in the Pre-crisis. The positive effects are in line with the literature (Dittmar et al., 2003; Ferreira & Vilela, 2004; Gill & Shah, 2012; Opler et al., 1999; Saddour, 2006). However, the effect on operating cash flow changed to negative in the Post-crisis period, which is in line with Kim et al. (1998). This could indicate that Norwegian listed firms use operating cash flow in order to maintain the operational and investments activities, instead of saving excess cash from the operating cash flow as cash holdings, as an effect of the 2008 financial crisis shock, while in the Pre-crisis period, the operational and investment needs are lower than operating cash

flow. Notably, when investigating firm characteristics, we see that operating cash flow negatively affects small firms in the Pre-crisis period, while the effect is positive for large firms. The negative effect for small firms turned positive in the Crisis period, while for large firms operating cash flow turned to an insignificant effect on cash holdings. This could indicate that the effect of the Crisis period had a greater impact on small firms than large firms. Further, the supportive theory changed from the tradeoff theory to the pecking order theory for small firms, which is in line with the general assumption that smaller firms tend to follow the pecking order theory.

We find that leverage negatively affects cash holdings, which aligns with most previous literature (Al-Najjar, 2013; Dittmar et al., 2003; Ferreira & Vilela, 2004; Opler et al., 1999). Our main results find no effect from the Crisis period on the leverage. However, when investigating firm characteristics, we find that leverage only becomes significant for cash holdings in the Crisis- and Post-crisis period for large firms. This could indicate that large firms increased their leverage during and after the 2008 financial crisis to extract more tax benefits, which is in line with the tradeoff theory. Another explanation is that the operational and investment activities exceeded the excess cash, which is in line with the pecking order theory. Further, we see that leverage is significant for small firms in all periods, however, for less profitable firms, the determinant is not significant in the Crisis period. Our initial assumption was that small firms tend to have lower profits than large firms. Therefore, we would assume that the same determinant would have the same effect for these two firm characteristics in the same period. Nevertheless, as the result shows, this is not the situation in our sample.

NWC has a significant negative effect in the Base- and Post-crisis period, which aligns with the literature (Al-Amarneh, 2015; Bates et al., 2009; Dittmar et al., 2003; Ferreira & Vilela, 2004; Opler et al., 1999), that NWC has a negative effect on cash holdings. These findings indicate that NWC is significantly used as a liquid substitute for cash in the Base- and Post-crisis periods. However, in the Pre-crisis- and the Crisis periods, NWC was not a significant determinant for cash holdings in the Norwegian market. This is interesting since we have observed that cash holdings reduced during the 2008 financial crisis. We have also observed that in the Pre-

crisis and the Crisis period, Norwegian listed firms had higher cash holdings than in the Base- and Post-crisis period and that in these two periods, the level of cash holdings fluctuated more than in the two other periods. We see that NWC has a significant negative effect on cash holdings for highly profitable firms in the Pre-crisis periods, while it is insignificant for less profitable firms. However, during the Crisis period, NWC was not significant for highly profitable firms. Further, in the Crisis period, NWC turns positively significant for less profitable firms, however, the effect turns negative in the Post-crisis period. The results in the Post-crisis period for less profitable firms are in line with the tradeoff theory, where firms can use NWC as substitutes for cash. However, the positive effect of the Crisis period is not in line with previous literature or theory of capital structure. A possible explanation for the positive effect is that Norwegian listed firms did not use NWC as a liquidity substitute for cash during the 2008 financial crisis. Due to the limited number of papers with similar analyses in the Norwegian market, we find it difficult to compare the positive effect of NWC.

Our results indicate that it is only during the 2008 financial crisis that profitability has a positive effect on cash holdings for Norwegian listed firms. The positive effect on cash holdings is in line with the findings of (Nguyen, 2006; Opler et al., 1999; Ozkan & Ozkan, 2004). Contrastingly, Dittmar et al. (2003), Gill and Shah (2012), Megginson et al. (2014), and Pinkowitz et al. (2013) all found that profitability had a negative effect. Further, we see from our further analysis that for growth- and less profitable firms, ROA has a significant effect on cash holdings in the Crisis period. However, this is not the case for more profitable firms and firms with less growth opportunities. This could indicate that ROA is used to accumulate cash by growth- and less profitable firms. This aligns with our general assumptions that the firm characteristics, high growth opportunities and less profits tend to apply to the same firms. We also see that ROA's effect on cash holdings for these firms is in line with the pecking order theory, which is in line with our expectations.

We find in alignment with the literature that firm size has a negative effect on cash holdings (Dittmar et al., 2003; Ferreira & Vilela, 2004; Gill & Shah, 2012; Nguyen, 2006; Opler et al., 1999), which is in line with the tradeoff theory. A possible explanation for the negative effect is the economy of scale. Another explanation

could be that larger firms are often seen as less risky than smaller firms, and could obtain less expensive debt, thus less need for cash. However, we find no further evidence of the effect of size on cash holdings by the financial crisis.

In line with Opler et al. (1999), Ferreira and Vilela (2004), Saddour (2006) and Gill and Shah (2012), Tobin's Q has a positive effect on cash holdings in all periods except the Pre-crisis period. This indicates that Norwegian listed firms with growth opportunities hold excess cash to act upon these investment opportunities in the Crisis- and Post-crisis period, which is in line with both the tradeoff theory and the pecking order theory.

Notably, our results are contrasting the literature Opler et al. (1999), Ferreira and Vilela (2004), Bigelli and Sánchez-Vidal (2012), Drobetz and Grüninger (2007), Ozkan and Ozkan (2004), Al-Najjar and Belghitar (2011) and Tong (2014) where literature shows evidence that dividend yield has a significant effect on cash holdings, while our results show no significance. The reason could be that the Norwegian market's dividend policy is significantly different from other markets, or that dividend does not affect the cash holdings. However, our results in table 10 indicate that dividend yield has a significant positive effect on cash holdings in the Crisis period for both less profitable and highly profitable firms. This could indicate that firms that pay dividends hold more cash in order to maintain the dividend payments to shareholders through the 2008 financial crisis.

The determinant capital expenditure shows ambiguous results in the literature, where Dittmar et al. (2003) find a negative effect on cash holdings, while Opler et al. (1999) find both negative and positive effects. Our results show a negative effect through all periods, and the main result shows no indications that the 2008 financial crisis affects this determinant. However, our further analysis shows that capital expenditures had no effect on cash holdings for small firms in the Pre-crisis period, while they became significantly negative in the Crisis- and Post-crisis period. This could indicate that the 2008 financial crisis affected capital expenditure's effect on cash holdings for smaller firms. A possible explanation for this is that smaller firms reduced investment to accumulate cash during the 2008 financial crisis. This aligns

with the general assumption that small firms tend to favour the pecking order theory.

For our results, we find little clear evidence of a change in the effect of the determinants on cash holdings due to the 2008 financial crisis for Norwegian listed firms. However, a noteworthy effect of the 2008 financial crisis is for operating cash flow which changes from a positive effect in the Pre-crisis period to insignificant in the Crisis period to a negative effect on cash holdings in the Post-crisis period. Further, for Norwegian listed firms, ROA only has a significant effect on cash holdings during the financial crisis. Our results show ambiguous results in line with which determinants are affected by the different theories. Additionally, our further analysis shows some evidence that there is a difference between the firms based on the firm characteristics. However, it is difficult to conclude based on this sample. Notably, we see that the R-squared is significantly higher for all periods for small firms and high Tobin's Q firms than large firms and low Tobin's Q firms. This could indicate that this model is a better fit for these firm characteristics. Further, this could also indicate that the general assumption of small firms having higher growth opportunities holds for Norwegian listed firms.

7. Conclusion

This paper examines which determinants affect the cash holdings for Norwegian firms listed on Oslo Stock Exchange between 2001 and 2018 and if the direction of the determinants changed due to the 2008 financial crisis. We study the determinants operating cash flow, leverage, NWC, ROA, size, Tobin's Q, dividend yield, and capital expenditures. To analyze the effect of the 2008 financial crisis on the determinants, we divide our sample into four sub-periods, respectively the Base period (2001-2003), the Pre-crisis period (2004-2006), the Crisis period (2007-2009), and the Post-crisis period (2010-2018). To increase the understanding about the effect of the determinants, we further analyze firm characteristics and if there is a difference between: small and large firms, defined as below and above the mean of size; low and high profitability, defined as below and above mean of ROA; low and high growth opportunity, defined as below and above mean of Tobin's Q.

Our data shows that on average Norwegian listed firms held more cash during the 2008 financial crisis than the average of the sample period (2001-2018). However, firms decreased their cash holdings during the 2008 financial crisis compared to the Pre-crisis period (2004-2006). We find that leverage, size, and capital expenditures significantly negatively affect cash holdings through all periods, indicating that they are not affected by the 2008 financial crisis. However, we find four determinants for cash holdings that are affected by the 2008 financial crisis. Operating cash flow is significant with a positive effect in the Pre-crisis-, while it is insignificant in the Crisis period, before the direction of the effect changes to negative in the Post-crisis period. NWC has a significant negative effect in the Base- and Post-crisis period, while it is insignificant in the Pre-crisis- and Crisis period. We find that it is only during the 2008 financial crisis that ROA is a significant determinant with a positive effect on cash holdings of Norwegian listed firms. Tobin's Q is significant with a positive effect on cash holdings in the Base-, Pre-crisis- and Post-crisis period, however, insignificant in the Crisis period. In contrast to most studies, we do not find that dividend yield significantly affects cash holdings for Norwegian listed firms. Further, our results from the analysis on firm characteristics show ambiguous significance and directions of the effect of the determinants on cash holdings. However, there are indications that firm characteristics are an important factor for how the determinants affect cash holdings. The findings in our research contribute to the literature by extending the knowledge regarding which determinants affect cash holdings for Norwegian listed firms and how the 2008 financial crisis affected these determinants.

We acknowledge that the analysis obtained relatively few observations, limiting the reliability of our results and argumentation. Further, the low amount of observations creates difficulty in challenging our results on firm characteristics. Due to the unbalanced dataset, the effects of the determinants might not reflect the true results. Further, the Hausman-test indicated endogeneity in our variables and suggested that we perform a FE regression rather than a RE. We still chose to use a RE regression model, indicating that there might be endogeneity bias affecting our results. Our research is limited to internal explanatory factors to explain the cash holdings, while other external well-documented explanations for cash holdings, such as VIX, tax- and interest rates. There is an individual assessment when defining the explanatory

variables, which might make the results less generalizable. We must also acknowledge the limitation of our data, where some of the obtained data from the database were missing, where we had to supplement with information from other sources. There were also detected outliers in the dataset. We adjusted the outliers for cash holdings which could affect the results. We are not analyzing unlisted firms, indicating that our results are not generalizable for the whole Norwegian market.

We believe our paper can be extended in several ways. Firstly, a natural extension would be to include more firms and thus more observations. This can be done by either turning to Norwegian unlisted firms or expanding the analysis to similar markets for listed firms, such as Scandinavian countries. Secondly, testing whether or not other variables have different effects on cash holdings, such as external firm factors, for instance, VIX, the interest- and tax rate. Lastly, one could analyze these results in light of other capital structure theories.

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Master Thesis

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holdings: An empirical investigation of Norwegian
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Preliminary Thesis Report

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Table of Contents

1. Introduction

In this paper we will study the question: "*Does Norwegian companies hold more cash during and after the 2008 financial crisis, and which determinants explain the cash holdings*?". The theory of Miller and Modigliani of a perfect market, suggest that there is no need for excess cash. Contrasting, the study of Bates et al. (2009) concluded that cash rates in the U.S. have doubled between 1980 to 2006, from 10.5% to 23.2%. There have been several studies on corporate cash holdings and why companies tend to hold cash, but little research on how companies change their cash holding and the determinants, during major business altering events. The papers on corporate cash holdings tend to be examining the U.S. market or other major markets, which indicates a knowledge gap on the theories in smaller markets.

There are written some master theses on the topic of corporate cash holdings in Norway, which all show an increase in cash holding in their period of study, but the theses are not in direct relation to a financial crisis (Arshad & Hoang, 2016; Ul Hassan & Valderhaug, 2016). Pinkowitz et al. (2012) studied the cash holdings of U.S. companies compared to foreign companies, and in their studies, they found an increase in cash during the financial crisis for both markets. Similarly, a study from the Jordanian market found an increase in cash during and after the crisis (Al-Amarneh, 2015). Due to the lack of research about corporate cash holdings in relations to financial crises we find it interesting to study the change in cash holdings and its determinants for Norwegian companies.

According to Attom (2013), referred to in Ahmad et al. (2018), cash management is the process of managing cash and short-term investment in order to ensure the solvency of the business. In other words, cash management is about cash-in-flow and cash-out-flow and cash balance (i.e. *cash holdings*). Cash holdings is the balance of cash that a company obtains. It is the result of the cash in- and out-flows. There are several ways to obtain and finance cash holdings and there are several motives to why a firm should obtain cash. There are three main theories that affect the financial structure of a company or what determines the "right" amount of cash. These theories are mainly the pecking order theory, the tradeoff theory and the agency theory. There are also originally three main motives to hold

cash, developed by John Maynard Keynes (1936), which are the transaction motive, precautionary motive, and speculative motive.

This paper contributes to the existing literature on which determinants of corporate cash holdings is focused on by Norwegian companies and how these companies determine their cash holdings in normal times and during the 2008 financial crisis. The findings of this paper may be useful to policy makes, financial institutions, and capital market participants, to better understand the liquidity issues and consequences during and after the crisis.

Further, this paper consists of the following sections: section (2) of literature review, section (3) of the research question, objectives and hypothesis of the paper, section (4) is theory related to the study, in section (5) we will elaborate on the methodology and the data that will be used in the paper, and lastly, section (6) is a description of the planned thesis progression.

2. Literature review

2.1. Cash holdings

The topic of determinants of cash holdings have been studied for a long time, but gained more attention the last couple of decades. However, as mentioned, there is limited research on how cash holdings are affected through and after the 2008 financial crisis. This paper wants to find evidence and reasons for how the cash holdings of Norwegian firms were affected by the 2008 financial crisis, and which determinants affected these changes.

The present knowledge about determinants of cash holdings, based on the pecking order theory, tradeoff theory, and the agency theory, with the motives of holding cash as the transaction motive, precautionary motive and the speculative motive in a normal, but imperfect market, has been studied for decades. Some of the most cited studies are supportive of these theories. An early empirical study which indicates these theories is the Nadiri (1969) study, which studied post war U.S. manufacturing firms. The study found determinants for why firms hold cash, in line with the theories mentioned. The results show that the long- and short-term interest rate are significant determinants for cash holdings. Further the findings indicate that the cash holdings are sensitive to factor prices and also the general

price level. Thus, the study concludes that the cash level fluctuates rapidly with the need for more cash, but with a target cash level.

The findings of Opler et al. (1999) exhibit many of the same results as Nadiri (1969). This study consisted of publicly listed firms from the U.S. in the period of 1971-1994, and the study supports the tradeoff theory. Firms tend to hold more cash as the benefit of excess liquidity is higher than the cost of liquidity shortage. Small- and growth firms tend to have higher cash ratios, while the large firms with great access to the capital markets tend to have lower cash ratios. However, firms that do well tend to accumulate more cash than the tradeoff theory predicted. These findings are in line with the transaction motive, that firms can continue their operations despite external financing being expensive. Further the study claimed that even though a portion of the excess cash is used on investments and payout to shareholders, firms do not tend to spend substantially more on these investments and payouts. Hence the study exhibits limited evidence of the speculative motive. Managers accumulate more cash if they have the opportunity, hence the precautionary motive for holding cash is excessively strong. Furthermore, the study concluded that the main reason for different cash holdings within a company are attributable to fundamental characteristics such as, firm size, profitability, growth opportunity and asset tangibility.

Contrasting the tradeoff theory, the agency theory does not imply a target level of cash holdings. Dittmar et al. (2003) differ from Opler et al. (1999), and poses the agency problems as a significant determinant for cash holdings. The study shows that there has been a large increase in cash holdings amongst the 11 000 firms they studied, which is confirmed by Bates et al. (2009) revealing that the cash holdings in the U.S. have more than doubled between 1980 to 2006, from 10.5% to 23.2%. Further the study of Dittmar et al. (2003) concluded that there were large differences in cash holdings between the countries, but also within the countries. The study pointed to agency theory as a reason for a higher level of cash holdings. Thus, the countries with poor shareholder protection rights tended to have up to twice as much cash compared to the countries with strong shareholder protection rights. Further the study found evidence of increased cash holdings when access to external capital is easier, and that other determinants such as asymmetric information and investment opportunities becomes less

important. The study lacked evidence of the consequences of having excess cash. However, Harford (1999) found evidence which indicates that firms with substantial excess cash in the U.S., with strong shareholders rights, use it on poor acquisitions and empire building. Contrastingly, Opler et al. (1999) find less evidence of excess cash being wasted in the U.S.

Other research points to many of the same conclusions as Opler et al. (1999) and Dittmar et al. (2003). Ferreira and Vilela (2004) also found evidence that countries within the Economic and Monetary Union with strong shareholder protection rights tend to hold less cash than countries with poor rights. However, the study indicates that capital markets development has a negative effect on cash holdings, contrasting the agency theory view.

The pecking order theory has to some extent been criticized the last couple of decades. Fama and French (2005) showed that the average equity issuance was larger than debt issuance in the period of 1983-2002. The study claimed that the reason for this is that the transaction costs were lower with modest asymmetric information for employee share issue, rights issue and share buyback. Saddour (2006) found similar results with negative relations for French firms. However, Leary and Roberts (2010), indicated improved significance for the pecking order theory, when firms allow debt level to vary with other factors associated with other theories such as the tradeoff theory. Further, also this study criticises the pecking order behaviour to be driven by incentive conflicts rather than information asymmetry.

2.2. Cash holdings during the 2008 financial crisis

The present research on the effect of cash holdings, and its determinants, through the 2008 financial crisis is limited to a handful of studies consisting of research such as a study from 2011 Campello et al. (2011), where the authors studied 800 firms from North America, Asia and Europe, and the effect of the financial crisis on internal and external capital, and the access to these. The study indicated that there was less access to external capital, and that the companies had to some extent, choose between whether they wanted to save or invest the internal capital. Further the study indicated that holding excess cash, eased the impact from the financial crisis. These indications are backed up by an empirical study from

Jordan of 47 listed firms (Al-Amarneh, 2015). The results of the Jordanian study concluded that companies tended to have higher cash holdings during and after the crisis, than under normal circumstances. The change in cash comes from both internal capital, by saving more cash, decreased investment activity, reduced payout to shareholders, and external capital by increasing debt levels. Further the study concluded that the results are consistent with previous theories about both the agency problem of accumulating more cash, and the pecking order theory of looking at internal capital before external. Also, in the study of Al-Amarneh (2015), the results support the claim that companies became more conservative for precautionary purposes.

3. Research question, objective, and hypothesis

As mentioned, the topic of cash holdings, and the determinants of cash holdings have been a subject for a long time. However, there are not many studies on the consequences of the 2008 financial crisis, therefore, it indicates a knowledge gap of research of cash holdings and its determinants during the 2008 financial crisis. According to the study of Al-Amarneh (2015), cash holdings increased in the crisis period and after combined with the pre-crisis period. Dittmar et al. (2003) showed that cash holdings between countries deferred to a great extent. Thus, examining the effect of the 2008 financial crisis might have significant different results between different countries. This paper wants to fill the knowledge gap, and contribute to the discussion on cash holdings, by looking at how Norwegian firms reacted to the 2008 financial crisis, and how the cash holdings were affected, and which determinants influenced these cash holdings by examining financial data from listed companies in the period 2001-2012. Further this paper will use the present theories on the topic, pecking order-, tradeoff- and agency theory, combined with Keynes (1936) three motives for holding cash. Thus, the research question this paper want to examine is:

" *Does Norwegian companies hold more cash during and after the 2008 Financial crisis, and which determinants explain the cash holdings?"*

The aim of this paper is to increase the knowledge of how Norwegian firms change their cash holdings to better equip policy makers, companies, and the financial institutions to predict how the Norwegian market will change through a

financial crisis. The objectives of this paper are to identify which theories and motives that explain the actions regarding cash holdings for Norwegian firms in such times and determine how this influences the Norwegian market. We will compare the explanatory motives and theories with similar research from other countries and either enhance the generalizability of the results (i.e., one can predict the same behaviour in different countries) or determine if this result is unique for the Norwegian market.

The hypothesis given below are examples of possible hypotheses for the paper. Further development of these will be done at a later stage in the paper after discussing the appropriateness of these, and the possibility for more/others with our thesis supervisor.

Hypothesis 1

During and after a financial crisis firms will decrease their investment activities.

Firms will reduce their investment activities as a means to accumulate cash.

Hypothesis 2

During and after a financial crisis firms will extend their debt.

Firms will use debt as a source for financing cash.

Hypothesis 3

After a crisis firms will decrease their dividend yield.

Firms will reduce their dividend yield after a crisis as a measure to accumulate cash.

4. Theory

4.1. Pecking order theory

The pecking order theory describes three ways of financing a company, retained earnings and internal funds, debt and new equity (Myers & Majluf, 1984). The theory suggests that there is a pecking order of which financing method a company should use. The preferred method is using internal financing, with cash from retained earnings ranked as the primary source of financing. When internal financing is unavailable, external financing is needed, with debt as the preferred, before issuing equity as the least preferred. The reason for the pecking order theory is to minimize the information asymmetry between managers and investors. With managers possessing more information about the firm than

investors, investors might assume that issuing shares could indicate that the company is overvalued, thus undervaluing, and underbidding the new shares. On the other hand, issuing debt could indicate that managers are confident in the company, hence the investors will think the investment is profitable. As an exception of the rule, issuing equity for tech or growth companies, could indicate profitable investments instead of an overvaluation of a company. The pecking order theory does not have a target cash level, but significant cash as a buffer between the investment decisions and retained earnings. The managers plan the company's dividend policy to investment decisions, so that they can use retained earnings as the favourable financing method.

4.2. Tradeoff theory

The trade of theory proposes that a company recognizes an optimal capital structure of debt and equity (target debt ratio), thus the cash holdings, by looking at costs and benefits of holding cash (Myers, 1977). The benefit of holding is the tax deduction due to interest on debt, while the cost is higher risks for the company associated with increased financial leverage, bankruptcy costs, and opportunity costs.

4.3. Agency theory

The last theory that could describe cash holdings is the agency theory (Jensen, 1986). This theory describes a manager's motives which could differ from investors motives. I.e., the managers undertake decisions which are in line with their own benefit, and not the shareholders'. Further the theory argues that the managers rather want to control a large company than a small one, hence retaining more cash to gain more assets under their control. Furthermore, increased amount of assets/cash could lead to a higher probability of empire building. To sum up, the agency theory could lead to excess liquidity needs in the company instead of paying the cash out as dividends to the shareholders.

As mentioned in the introduction, Keynes (1936) developed three main motives to hold cash, and to this date, these motives are still the most recognized. The three motives of Keynes (1936) are the transaction motive, precautionary motive, and the speculative motive.

4.4. Transaction motive

Preve and Sarria-Allende (2010) describe the transaction motive as the fundamental idea that a firm needs cash to run its business. Therefore, a firm holds an amount of cash to be able to handle its transactions over a period of time. What would then be the optimal level of cash, and the answer depends on the firm. Cash balances have both upsides and downsides. A higher amount of cash holdings will decrease the risk of liquidating assets on short notice, but at the same time it increases the opportunity cost by not investing the excess cash. Therefore, the cash holdings will fluctuate between different industries, where the opportunity cost is higher or lower. Preve and Sarria-Allende (2010) also indicates that there are economies of scale related to the transaction motive. I.e., the cash-to-asset ratio has a negative relation to the size of the firm.

4.5. Precautionary motive

The precautionary motive is the assumption that companies hold cash to counter the uncertainties surrounding its future cash flow. This could either be because of shocks, or simply because of fluctuations in a company's cash flow. Thereof, one can expect that companies that are related to higher risk, will hold a higher amount of cash than a company with lower risk (Preve & Sarria-Allende, 2010). Also, in this motive, the authors claim that optimal cash holdings have a positive relation to the amount of transactions, while there is a negative relation with the interest rate.

4.6. Speculative motive

The speculative motive is based on the assumption that a firm holds cash in case of a positive shock, which will enable profitable investments or the possibility for growth (Preve & Sarria-Allende, 2010). To be able to act on these opportunities, firms need to hold higher cash balances since cash enables them the opportunity to act on the opportunities when they arise.

5. Methodology and data collection

5.1. Panel data analysis

We want to analyse the change in Norwegian firms' corporate cash holdings over a set time-period. The variables that will be observed over time will be numerical, and we will therefore conduct a panel data analysis of the data (Saunders et al., 2015, p. 551). According to Saunders et al. (2015, p. 200), the strength of

longitudinal studies is its ability to study change and development over time. Also, due to the limited time frame of this paper, we have to rely on databases with secondary data, which also fits with this type of data analysis. Since this paper will conduct a similar study to Al-Amarneh (2015), we will collect data from 2001-2012. We will also divide the data into four periods. We will call the first period 2001-2003 the base period. The second period 2004-2006 we will call the pre-crisis period. 2007-2009 will be the crisis period. And lastly 2010-2012 will be the post-crisis period. We divide into four periods to be able to observe different changes and behaviour in the different periods.

This paper will mainly use STATA when conducting regression analysis and hypothesis testing. To analyse the panel data, we can use either the pooled ordinary least squares (POLS), fixed effect - (FE) and random effect - (RE) method (Adkins & Hill, 2011). According to Bell et al. (2019), FE is often the more preferable method, while they themself prefer a well specified RE. A similar study to this paper conducted in Jordan used RE, while another study about labour law and cash holdings in Norway used FE (Al-Amarneh, 2015; Arshad & Hoang, 2016). It is possible to perform a Hausman-test on the data to rule out if it is possible to use RE, and if not, use the FE (Bell et al., 2019). If the Hausman test rules in favour of FE, we can do a Wald-test, to determine if one should use FE or POLS. Before deciding which method we will use, we will discuss the different methods with our supervisor and run the different tests on our data.

We have not specified the exact model at this point of time and will determine this at a later point in the thesis. It is interesting to look at the model of Al-Amarneh (2015) who conducted a similar study in Jordan. She tested the following regression model, where in the expression i is the firm indicator and t is the time indicator:

$$CASH_{i,t} = \alpha 0 + \alpha 1\ CF_{i,t} + \alpha 2 CapExp_{i,t} + \alpha 3 NWC_{i,t} + \alpha 4 LVRG_{i,t} + \alpha 5 SIZE_{i,t}$$
$$+ \alpha 6 DIVY_{i,t} + \alpha 7 TOBINQ_{i,t} + \alpha 8\ ROA_{i,t} + \alpha 9 Financial\ Crisis\ Dummy + \mu_{i,t}$$

Where $\mu_{i,t}$ is the error term of the model. Al-Amarneh (2015) description of the model is in Table 1 in the appendix. We will get further into each variable at a later stage in the thesis.

5.2. Data

When collecting data for the thesis, we will use the CCGR (Center for Corporate Governance Research) database. We have access to the CCGR through BI, and we can use it to collect the accounting data needed to perform the analysis needed. The CCGR database contains a total of seven tables:

1. Account_Data: Accounting data from 1994 to 2015.
2. Consolidated_Account_Data: Consolidated accounting data for 1994 to 2015.
3. Industry_Code: NACE industry codes for the companies from 1998 to 2015. A company can be member of more than one industry.
4. Ownership_Control: Governance data from 2000 to 2015.
5. Misc_1994: Misc. data from 1994 to 2015.
6. Misc_2000: Misc. data from 2000 to 2015.
7. Misc_2009: Misc. data from 2009 to 2015.

We will need the accounting data, but the exact data we are going to collect and request, will be determined at a later stage. The CCGR was founded in 2005, is maintained by the IT department at BI and has several sources for financing such as the business community, the Research Council of Norway and from BI. Due to the several stakeholders involved and how invested BI is in this database, we are confident that the data available on the database is accurate.

6. Thesis progression

The plan for thesis progression is a rough estimate and will likely change throughout the semester. We want to finish the introduction, and theory section of the thesis by mid- February. Further we want to spend one-two weeks of choice of methodology, before we start the data collection late February. We will spend the next two months, March and April, on the data collection and data analysis (STATA). In May, we will analyse the results of the data analysis, and elaborate the results in the thesis. Lastly, we will spend the last month, June, on reviewing the thesis, and concluding matters.

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Appendix

Table 1. Variable definition

Variable	Full Name	Description	Predicting
Cashratio	Cash ratio	Cash and cash equivalents / Net Assets.	Cash holdings
Capexp	Capital Expenditure	The annual change in fixed assets added to depreciation.	Investment Activity
Cashflow	Cash flow	(net profit After tax + Depreciation) / Net Assets.	Business operations
Leverage	Leverage Ratio	Total debt / Net assets	Financial Leverage
NWC	Net working capital	(Current assets- cash and cash equivalents – current liability) / net assets.	Liquid Asset Substitutes
ROA	Return On Assets	Net income / net assets.	Profitability
Size	Firm size	Natural logarithm of Net assets	Financial constraints
Divyield	Dividend yield	Dividends paid / stock price	Financial constraints
Tobinq	Tobins' Q	(Book value of debt + Market value of equity) / book value of assets.	Long-term growth